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Forthcoming Events.

APRIL 11.

Institute of Metals (Sheffield Local Section):—Annual general meeting. "The Protection of Aluminium by Electro-Plating," Paper by Mrs. A. Vellan and Professor Desch.

APRIL 15.

Sheffield Metallurgical Association:—Ordinary meeting at Sheffield. "Some Notes on Tin Bar Steel and Tin Plates," Paper by R. Longley.

APRIL 16.

Sheffield Society of Engineers and Metallurgists:—Meeting at Sheffield. "Some Researches in the Safe Use of Electricity in Coal Mines," Paper by Dr. W. Thornton.

APRIL 17.

Institute of British Foundrymen (London Branch):—Annual general meeting in London. "Pearlitic Cast Iron," Paper by A. Marks, F.I.C.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Psychology in Foundry Practice.

Foundrymen have, during the last ten years, had introduced to their notice various psychological aspects of their work. Motion and time studies have been carried out at a Midland foundry, whilst some American firms have introduced vocational suitability based on an examination by a professional industrial psychologist.

In a recent Paper presented to the London Branch of the Institue of British Foundrymen, Mr. Gardom, in a study on "Malleable Iron Chain," stated that the system of making machine moulders fetch their sand and cores and knock out their castings permitted of a larger output being obtained than by having this work done by ordinary labourers. The enhanced production was ascribed to the elimination of monotony. Now, until recently it has been axiomatic in British works practice that it is not economical to allow a skilled or semi-skilled man to perform work which can be equally well done by the cheapest form of labour. The latest and best-informed opinion on this subject is in agreement with Mr. Gardom. Possibly it has been based on some laboratory experiments carried out in Italy, wherein a man lifted with his little finger a fairly heavy weight continuously. After, say, 35 times his finger became numbed, and remained so for, say, two hours, when he could resume the test. His output in an eight-hour day amounted to, say, 120 lifts. By introducing a system of rest pauses, and so preventing numbing supervening, the number of lifts could be very materially increased. If, then, one replaces the word "numbing" by "fatigue," and perhaps "monotony" too, the modern basis for the study of quantity production under the best conditions is revealed.

Psychological examination for vocational suitability is still in its infancy, but it has been applied in some American industrial organisations. A story is told of such a concern, having many branches, one of which was losing money. The administration decided to transfer one of its most successful managers to this branch. He arranged to make a preliminary survey *incognito*. On arrival at the branch he found himself being interviewed by the "vocational-suitability" expert, who decided he was totally unfit to control men, but would make an excellent clerk or labourer. The expert was the first person to be dismissed under the new *régime*. Whilst this phase of psychological application does not appeal to us as being practical, there is much to be said for the inclusion of the subject in the curriculum of university engineering and metallurgical courses. It might prevent the occurrence of the following typical disaster. A routine chemist caught the eye of the managing director, who promised if he did certain work he would be promoted to assistant technical manager. When the time arrived, the chemist was offered a foreman's position at double his salary. The chemist refused the job on the ground of lowered status, and preferred to be out of work. As a foreman he would have learnt to control men, carry out factory regulations, picked up a knowledge of health, unemployment and accident insurance, gained experience in processing and maintenance. This is just the experience for which firms are prepared to pay when combined with a technological knowledge. Apparently but few men have ever given a thought as to the acquisition of knowledge and experience which has a high market value, and the majority of those possessing it appear to be unable to present it in such a form that it will appeal to the man selecting a candidate.

Employment of Scrap in German Iron and Steel Industry.

The use of scrap plays an important part in the German iron and steel industry. During the war and the years immediately following it, the production of pig-iron has permanently remained under that of steel, and a change has also taken place in the percentages of individual kinds of steel in relation to the total output. Before the war the steel output had only occasionally exceeded that of pig-iron.

Thus, for instance, the production of steel exceeded that of pig-iron by 1,129,000 tons in 1914, by 2,897,000 tons in 1916, 2,621,000 tons in 1918, 1,223,000 tons in 1919 and by 1,975,000 tons in 1920. At the same time the output of basic Bessemer steel, with a decline of 35 per cent. in the total output of steel (post-war Germany without the Saar) decreased from 5,406,000 tons in 1913 to 2,711,000 tons in 1922, or by over 49 per cent., whereas the output of basic open-hearth steel decreased from 6,602,000 tons to 5,262,000 tons or by 20 per cent. only in the same period. Of the total production of steel in 1913, basic Bessemer quality in post-war Germany without the Saar represented 42.3 per cent., and only 32.4 per cent. in 1920, while in the case of basic open-hearth steel the percentage rose from 51.7 to 63 per cent. in the same interval.

The preceding figures show the changes that have taken place in the years in question, which were brought about by the fact that Germany was formerly largely dependent upon foreign countries for her supplies of ores, of which over 14,000,000 tons were imported in 1913. An adequate supply of foreign ores, however, became impossible during the war, while subsequently the ironworks were unable to buy foreign ores as owing to the falling mark they were too dear, more especially so as greatly increased imports would have become necessary in consequence of the loss of 80 per cent. of the national iron-ore resources. Under these circumstances the iron and steel industry was compelled both during the war and in succeeding years to make large use of scrap in place of ore in the blast furnaces and also to use it more freely in open-hearth furnaces than had hitherto been the case. As a consequence, the importance of scrap to the German iron and steel industry increased year by year. In 1913 scrap only formed not quite one-third of the material used by the ironworks and the foundries; in 1919 it amounted to three-fifths and in 1920 the proportion reached over two-thirds. As a sufficient supply of scrap was not available in the home market, it was necessary to import large quantities in order to meet the growing demand.

As regards the balance of imports and exports of scrap there was an import excess of only 16,000 tons in 1913; in 1920 the excess of imports over exports amounted to 58,000 tons, in 1921 to 162,000 tons, and in 1922 to 502,000 tons; but in 1923 the exports of scrap at 380,000 tons exceeded the imports by 225,000 tons. The large excess of imports over exports in 1922 is explained by the fact that in that year an ordinance was issued temporarily permitting scrap to be imported free of duty. The reason for the imports of scrap having only amounted to 155,000 tons in 1923 as compared with 600,000 tons in 1922 is ascribed to the occupation of the Ruhr and the consequent isolation of the chief scrap-consuming district in Germany. As a result of the operation of agreements and the policy of freights on long-distance traffic, large quantities of scrap were exported to Polish Upper Silesia and to Czecho-Slovakia last year. Scrap could be sent on more advantageous terms from Bavaria to Czecho-Slovakia on the one hand, and scrap imported from Holland in substitution or in larger quantities on the other hand.

To help the trade in scrap an exchange has been established on the Ruhr. As far back as last June a number of Hamburg scrap merchants had formed there an exchange; this was, however, apparently not attended properly, and only existed for four months. Although no proper explanation has been forthcoming as to the real causes of the failure of the venture, it is surmised that it was brought about by the refusal of some leading Hamburg firms to support the exchange because they were of opinion that price quotations hampered their business and they therefore persistently opposed the exchange until it ceased to exist.

During last year the Düsseldorf Chamber of Commerce, which for many years had transacted business in iron, steel and coal, entered into negotiation with some scrap dealers in Westphalia with a view to the constitution of an exchange, but owing to the occupation of the Ruhr the matter had to be postponed. Now, however, that the situation on the Ruhr has somewhat improved, the Chamber is making preparations for the resumption of quotations for coal and iron and steel, and at the same time the scheme for the inclusion of dealings in scrap has also been carried into effect. Towards the end of January the Rhenish-Westphalian scrap dealers decided to establish an exchange of their own at the suggestion of the Chamber of Commerce, and the statutes of the new institution were approved at the end of February. The exchange is now actually established with fortnightly meetings in Düsseldorf.

So far the meetings have only been attended by representatives of the scrap-dealing firms. As some of the merchants are closely associated with works and have long-term contracts with them, these particular works may be said to be indirectly represented on the exchange. The following works, for instance, are represented on the board of management of the exchange:—Allman & Altmeyer, Düsseldorf (the Stumm group); the Sonnenberg A.G., Düsseldorf (Phœnix Company); Kaufmann & Lipmann, Düsseldorf (Rheinstahl Company); and Klöckner & Company, Duisburg (the Klöckner group).

The reasons for the abstention from the exchange of consumers of scrap are stated to be a belief that speculation would send up prices and that their regular attendance would entail large expenditure. Nothing has hitherto been heard of the prospective attendance of the third group as represented by the suppliers of scrap. It is considered, however, that this group also has no inclination to attend the exchange as their business has proceeded quite smoothly with the group under the present method of effecting sales, namely, by playing one merchant off against another. The new institution is not an exchange in the true sense of the word, because only a part of the works' demand is dealt with on 'Change, and at the same time the usual schedule of quotations of prices is lacking. As a consequence, the exchange may be considered merely as a meeting place of the dealers in scrap. Most of the business will for the time being remain outside the new institution, although a change in this respect will take place as soon as the proposed iron and steel exchange is established which has been resolved upon by the Düsseldorf Chamber of Commerce after a conference with representatives of the iron and steel industry.

The Engineers' Club—First Annual Dinner.

The first annual dinner of the Engineers' Club is to be held on May 6, at the Connaught Rooms. Members of His Majesty's Governments, past and present, many distinguished scientists, metallurgists, engineers and architects have accepted invitations.

Third Census of Production.

In accordance with Section 9 (1) of the Census of Production Act, 1906, the President of the Board of Trade has appointed the following gentlemen, together with officials of the Home Office and the Board of Trade, to be a Committee for the purpose of advising the Board as to the preparation of the forms and instructions necessary for the taking of the Census, and the making of any rules under that Act:—Mr. T. J. Arnold, J.P., Sir Arthur Balfour, K.B.E., Sir Hugh Bell, Bart., C.B., Professor A. L. Bowley, Mr. Stephen Easten, O.B.E., J.P., Sir Henry J. Gibson, K.C.B., Mr. Kenneth Lee, Professor D. H. MacGregor, Mr. R. C. Perry, C.B.E., Sir W. Peter Rylands, Mr. Arthur Shaw.

The Committee will hold its first meeting at an early date. The Secretary of the Committee is Mr. G. A. G. Stanley, Board of Trade, Great George Street, London, SW.1, to whom all communications should be addressed.

The Operation of a Brass Foundry under Scientific Control.*

By FRANCIS W. ROWE.

In the present strenuous times through which the engineering and allied industries are passing the need for scientific operation in factories is more vital than ever. This is even again more emphasised in the founding industry, which has never been noted for progressive methods in the conduct of its business. There are many large and important foundries who are still working on what are practically "rule of thumb" methods, and who are without any reliable data regarding the costs, times, etc., in connection with their business.

This, unfortunately, affects the trade at large, as there are firms who unconsciously quote for work at an uneconomical figure. The ultimate end of such a procedure can only be the bankruptcy courts. Whilst other firms, playing for safety and without reliable cost data, are quoting prices much too high, and thus restricting the amount of work coming in and increasing the overhead charges.

Unfortunately, the systematisation of foundries both as to procedure and records, where such exists, is most frequently done by those who have no adequate knowledge of the details and requirements of the business. This illogical state of affairs has arisen chiefly because of the apathy of the foundryman to this very essential side of his business. The cost accountant's ideas of control have frequently been dilated in technical literature, and it is proposed in this Paper to deal with those portions which can only be dealt with by one familiar with the details of the industry.

The operation of a brass foundry on a scientific basis implies to most people the services of a laboratory and a staff of chemists replete with the paraphernalia of their professsion.

Although these are a very desirable adjunct to a well-conducted foundry they are by no means a be all and end all.

The shops with which they are connected must be worked on well-organised systems if the full value is to be obtained from the technical metallurgical staff. Failure to recognise this fundamental has many times resulted in a laboratory failing to realise the high hopes which preceded its installation.

Metallurgical Qualification Insufficient.

Unfortunately, too, many metallurgical chemists, whilst thoroughly capable as regards their own particular sphere, have not the necessary experience to enable them to detect or remedy defects in organisation which are letting the foundry down, and thus receive the blame for mistakes and faults which are not really due to them.

Where a defective system of organisation exists in a foundry the most skilled metallurgical service will effect practically no good and mistakes and confusion will continue to occur.

It is presumed, throughout this article, that a foundry is being dealt with which is desirous of turning out first-class castings to meet stringent specifications (either internal or external) as regards chemical analyses and physical tests.

Naturally one of the first essentials to a brass foundry is a thoughtfully planned shop. It has been the writer's privilege to inspect a good many brass foundries in this country, and all the really well laid out foundries he has seen could be numbered on the fingers of one hand. Too much thought and time cannot be spent in laying out a foundry, as it should be firmly realised that consistent good work at an economical price cannot emanate from one which is badly designed.

Layout of Brass Foundries.

One of the most frequent defects in brass founding layouts is insufficient space and *cul-de-sac* gangways. Nothing is more distressing than to see a machine moulder with his face within 2 ft. of a blank wall, hemmed in on either side with his piled up box parts and an 18-in. gangway up which all his metal and sand must come.

Another feature which is frequently overlooked is the length of travel that is undergone by, say, the virgin ingots before they are shipped in the form of finished castings and the heads remelted. It is not an infrequent occurrence to see them pass and repass over the same ground two or three times whilst in the transition stage. The metal should describe in its travels as near a complete circle as possible.

That is, it should enter the circle at the stores from the railway sidings (in the case of virgin metal) or from the machine shop (in the case of home scrap), travel from there to the melting furnaces, from there to the moulders, then fettling shop, then (both castings and heads) back to the stores, and there the castings go outside and the scrap travels on again.

An objectionable feature with many foundries is the placing of furnaces, either pit-fire or tilting furnaces, close up to a blank wall. This usually means that the space in front of the furnace is filled with crucibles, furnace tools, shanks,

FIG. 1.—*This Form is Sent on Receipt of a Consignment of Copper by the Storekeeper to the Laboratory with Samples for Analysis.*

COPPER	Brand:	Ref. No.
Suppliers		
Quantity	Delivery Date	Price per ton
Stored in Bins No.		
To be Used for Mixings No.		
Remarks:		
Storekeeper.	Metallurgist.	

Analyses	Their Analysis	Our Analysis
Element	Their Letter	Date Reptd.
Copper		
Arsenic		
Lead		
Antimony		
Oxygen		
	Analyst	

and charges of metal, whereas it should be perfectly clear to allow of ease in handling the metal.

Stores.

One of the most important items in a brass foundry is the provision of a suitable stores. This should be amply large enough to allow of perfect segregation of all classes of scrap and ingot materials. The duties of the stores should comprise the reception of all metals, whether virgin ingots, home or outside scrap. The preparation of such material for melting, *i.e.*, magnetting, supervision of the ingotting of borings, and sorting. The weighing and issuing of all charges and records in connection with materials. The reception and issue to the shops of all finished castings from the fettlers.

No metal should be melted without having been weighed out of the stores. That is, all heads and runners and defective castings must be returned to the stores to be again issued as part of a new charge. In this way reliable production figures are obtained, which in many foundries are neglected or inaccurate. Without any further effort

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* A Paper presented to the Newcastle Branch of the Institute of British Foundrymen, Mr. James Smith presiding.

on the part of the storekeeper, the essential items are available immediately. That is: (*a*) Total metal melted; (*b*) total castings made; (*c*) rejections in foundry; and (*d*) rejections outside foundry. A form of procedure which has been found to work admirably is as follows: All the metal stocked is segregated into the different grades, classification and alloy numbers. Thus 25 tons B.S. copper delivered against o/No. 8731 from Blank & Company would be stored in a separate bin Lot No. 187, and a sample analysed and instructions for its use issued, calling it by lot number. As soon as such material is received the storekeeper fills in his portion of a reference card as in Fig. 1 and forwards it to the laboratory together with the necessary samples for analysis. When analysis is completed, the purchasing department is informed of the quality of the material and the storekeeper advised as to its use.

Recording Stocks.

All turnings from the machine shops after magnetting are melted in 800-lb. lots, and after ingotting are stacked and a sample analysed.

Fig. 2.—*Record Card (Front and Reverse) for Remelted Turnings.*

RE-MELTED BORINGS		Grade *No. 7*		Ref. No. *368*
Origin	*Machine Shop Borings*			
Quantity Weighed In	*842*	Date	*19/2/23*	% Loss
After Magnetting	*831*		*24/2/23*	*1.31*
After Re-Melting	*802*		*26/2/23*	*3.48*
		% Wt. of Metal		
To be Used for	*No. 7*	Lot No.		*211*
Remarks:				

Storekeeper: *T. W. D.*

Analysis.		Additions per *100* lb. Used.	Grade	Alloy. *No. 7*
Copper	*87.9*	Copper	*3*	*5*
Tin	*7.3*			
Lead	*1.6*	Tin	—	—
Zinc	*4.4*	Lead	*1*	*1½*
Phosphorus	*0.03*			
Iron	*0.16*	Zinc	*2*	*2*
Nickel	—			
Aluminium	—			
Analyst	*H.V.R.*	Maximum % To be Used	*33⅓*	
Date	*1/3/23*			

The record of these borings is kept on a 6-in. × 4-in. index cards as in Fig. 2. The cost office is enabled to ascertain the true value of this scrap from the cards and allocate accordingly.

The reverse side gives the necessary corrections to be added to bring the alloy up to standard and the maximum percentage to be used to form part of a charge. The metallurgist is furnished with a weekly stock list and issues his instructions for the making-up of the charges accordingly. Thus for any alloy the proportions one week might be (for 200-lb. charges) 75 lbs. virgin metal, 75 lbs. remelted borings, and 50 lbs. of heads and runners. If the stocks of remelted borings for that particular alloy fell low and a large stock of heads and runners, defective castings, etc., accumulated, this might be altered the next week to 75 lbs. virgin metal, 20 lbs. remelted borings (plus corrections), and 100 lbs. heads and runners.

Charge Sheets.

Fig. 3 shows a form of charge sheet which has been found to give excellent service and facilitate costing and record systems. These charges should be weighed out into a box for easy transference to the furnaces. It is not an aid to careful working to have charges piled loose on the foundry floor.

The charge sheets are made out in duplicate and the copies forwarded to the cost department day by day or week by week as is most convenient. The costs of each melt are filled in, and thus a true cost per lb. of each melt is ascertained. The scrap, when emanating from the shops, is given a definite value based on analysis, handling, magnetting and remelting costs. Scrap bought outside is, of course, costed at its purchase price plus a sum necessary to cover any extra handling costs over virgin materials, such as sorting, extra analyses, breaking, etc.

Naturally, from a simple addition of the weight on these charge sheets daily or weekly, the store obtains the total metal melted figure.

All castings going out are weighed, and all heads and runners, etc., are weighed in from the dressing shop. Thus by subtracting the totals of these two from the metal melted total, we have the melting losses.

A weekly report is prepared and embodied on a 6-in. × 4-in. card as in Fig. 4. The obverse side of the cards contains these figures analysed for the different alloys. Thus the management is enabled to see at a glance which alloys are proving troublesome and the general progress of the department.

For every alloy made it is also desirable to have the full instructions for melting and casting embodied on cards. Such a card for Admiralty gun metal is illustrated in Fig. 5. The casting temperature should be carefully determined by experimental work on the actual castings, paying due regard to strength and soundness. These figures very often take some time to obtain, but if obtained by carefully watching results over long periods form a permanent guide. Similarly with any but the simplest work records should be kept of the methods adopted for moulding and casting jobs. Records should include the unsuccessful as well as the successful procedure. In this way a permanent record is established and repetition of old mistakes avoided. In a great many foundries their long association with the business is wasted. It only needs a change of foreman and the whole process of accumulating knowledge on ticklish work must begin again.

Inspection of Castings of New Design.

One of the simplest and safest procedures to adopt with complicated or important castings of new design is invariably to break the first one or two made and subject them to close inspection for draws, porosity, etc.

This has always proved an economical procedure, and is much to be preferred to the general method of plunging headlong into mass production of a new casting only to find, in a percentage of cases, after 50 or 100 castings have been made that a radical defect exists.

Where persistent defects of a minor nature appear in one particular type of casting or alloy a specially arranged procedure should be followed. The method of moulding, running and casting should be carefully studied, and alterations should be made *one at a time*. Two days' work should be made with the first alteration (assuming, of course, quantity production), all castings made with this altered method being marked with distinguishing number or letter. Then, if it is thought necessary, a further alteration is made, and two further days' work cast, and so on until no further improvements can be thought of. Then when the work has passed through the shops a detailed study of the results can be made. The weakness which the adoption of such a system seeks to avoid is the error of drawing conclusions and altering methods on the results of isolated experiments made most probably under ideal conditions.

Also detailed records of the various alterations tried is most helpful in designing procedure for new work.

Melting and Casting Procedure.

One of the oldest axioms which cannot be over-emphasised or repeated too often is to melt rapidly. The present melting furnaces in use in foundries are such that all molten metals and

alloys contain a large quantity of gas, and the longer time it is kept in contact with the products of combustion the more gas the metal absorbs. A large number of failures in brass founding are due to the metal being stewed. Some alloys are a great deal more susceptible than others, but no alloy is by any means proof against ruination by stewing. The metal should be melted under a charcoal cover. The writer has investigated the possibilities of various fluxes, and covers both proprietary brands and otherwise, but for the ordinary run of foundry alloys such fluxes and covers possess no advantages over charcoal.

FIG. 3.—*Form of Charge Sheet.*

Date *17-9-23.*

Ref. F878 5m. BRASS FOUNDRY.

Alloy or Mixture No. *9* Melt No. *17* Fire No. —

Metals Used.	Weight Lbs.	Rate.	Value.
Copper Ingot :	*92*		
Lot 7			
Tin Phos : *18*	*11*		
Spelter			
Lead	*6*		
Scrap :—Yellow Brass			
Ordinary Brass			
A.G.M.			
A.R.B.			
T.P.B. *Lot 260*	*30*		
S.H.B.			
Spr. Metal			
No. 9 Alloy	*100*		
Totals ..	*249*		

COST PER LB.

The ordinary bronzes, such as Admiralty gun metal, phosphor bronze, etc., should be superheated to a temperature of 1,250 deg. C. to allow the metal to have such liquidity as will allow the dross readily to rise to the top.

After drawing from the fire, the pots should be well stirred and volatile constituents added, and the metal cooled to casting temperature.

Casting Temperature.

Too much emphasis cannot be laid on the proper control of casting temperature, both to ensure soundness and the correct mechanical strength in the metal.

Pyrometers should be used consistently. One many times hears the statement that it is impossible to use pyrometers regularly in a brass foundry, but these assertions are usually made by people who have never tried to use them, or at any rate never tried with any enthusiasm.

A great deal, of course, depends on the type of pyrometer selected. For works use it is essential that the lag should be as small as possible. Therefore a couple with heavy protecting sheaths is of very little value owing to its insensitiveness to fairly rapid temperature changes. The author has found two types to be quite suitable for constant use in a brass foundry. The first is the Foster base metal bare thermocouple, with pivoted indicator and armoured leads.

The thermocouple consists of two wires, one nickel-chromium and the other nickel-chromium-iron, both being approximately $\frac{1}{8}$ in. thick.

These are covered with asbestos sleeves and fireclay.

The wires are welded together at the tip and fixed in a very convenient head, which forms the handle. Compensating leads (which transfer the cold junction to the indicator) run from the head to the indicator. These are armoured by steel flexible tubing to prevent mechanical injury. The indicator (or millivoltmeter) is of the pivoted type and is very robust.

After the first or second immersion the tip burns off, but there is no need to rejoin the wires, as they form contact through the molten metal. This type of instrument is very suitable for all alloys having a reasonably clean surface, such as phosphor bronze and Admiralty gun metal, but gives somewhat erratic readings on high zinc alloys due to oxidation of the immersed wires. Naturally, if the wires at the tips become oxidised the resistance in the circuit is very much increased and the indicator reads low.

For alloys where this type is not suitable the writer has found the standard platinum—platinum rhodium pyrometer—to give excellent and economical service. A three-foot couple is used, encased in a $\frac{1}{2}$-in. dia. silica sheath. At first sight a silica sheath seems a fragile affair, and a rare metal couple an expensive item to put into a bronze foundry for everyday use. But given a modicum of care and intelligence on the part of the workman, this type of pyrometer is less expensive to maintain than the one previously described. The silica sheath should not be immersed more than 3 in., and should be carefully examined periodically for sign of disintegration. The silica sheath will last two or three hundred immersions before needing replacing, and then can have the three or four inches which is corroded cut off and the tube resealed for use with shorter thermo couples. The tubes should be replaced before they actually go or are in danger of failure, otherwise one will lose two or three inches of couple, which is an undesirable though not very expensive event. Should the metal attack the couple, the affected portions should be cut off and the ends rewelded together. The internal resistance of the type of indicator used with these thermocouples is such that the length of the couple makes an inappreciable difference to the reading.

The temperature of the metal should be taken immediately prior to pouring with the pot standing by the mould.

The casting temperature should be fixed with due regard to other factors. That is the thickness of the section of the casting, the condition of the mould, *i.e.*, dry sand and green sand, and, most important of all, the size of the runners and the length of travel of the metal.

The ideal to be aimed at in bronze founding is to fill the mould as rapidly as possible, if possible from a number of points, so that every part of the mould is filled with metal at the same temperature.

The great tendency on the part of the brass foundryman is to use a higher temperature than necessary. It should be realised that the best

FIG. 4.—*The Weekly Report Card (Obverse and Reverse).*

BRASS FOUNDRY REPORT for Week ending *23/9/23.*

		Lbs.	
1	Total Metal Melted		
2	Total Castings Made		% of 1
3	Rejected in Foundry		% of 2
4	Rejected in Shops		% of 2
5	Nett Output		% of 2
6	Total Coke Consumption		% of 1

Alloy	Melted	Castings Made	Rejected Foundry.	Rejected Shops	Nett Output	% Rejected
1	*6,370*	*5,351*	*113*	*229*	*5,009*	*6.40*
2	*11,426*	*9,598*	*272*	*479.5*	*8846.5*	*7.83*
3	*2,304*	*2,028*	*36.8*	*8*	*1983.2*	*2.21*
5	*9,620*	*6,926*	*383.25*	*299*	*6243.75*	*9.85*
7	*660*	*508*	*11*	*41.25*	*455.75*	*10.29*
11	*840*	*459*	*Nil.*	*20*	*439*	*4.36*
15	*2,840*	*2,372*	*217.3*	*119*	*2035.7*	*14.18*

strengths and soundness of metal are obtained from what the average foundryman would call cold metal.

For instance, the majority of foundrymen would call 1,100 deg. C. a ridiculously low casting temperature for light-sectioned work in Admiralty gun metal. Yet given an opportunity to run a casting in several places at the same time, with metal at this temperature the soundest and strongest castings can be produced. A man who runs, say, a 2-ft. dia. ring with one runner in one place needs metal which is far too hot to give good strength in order that the metal will "stay" the distance.

One often sees metal going into the runner like water and coming up the riser like treacle, which is always indicative of shockingly poor moulding practice.

In cases like this it is obvious one side of the casting has been poured with metal about 1,250 deg. C., and the other side with metal about 1,050 deg. C.

Finally, to bring the above somewhat disjointed notes to a conclusion, it cannot be too strongly urged that the only experience and knowledge which is of any lasting value either to a firm or the trade at large is that recorded on paper in hard facts and figures.

A firm whose knowledge and experience of its business is dependent absolutely on the memory and experience of its executive staff is depending on a poor reed.

As before remarked, a change of personnel, which may happen any time, is all that is required to necessitate the whole weary and expensive process of accumulating experience being started again.

Fig. 5.—*Instruction Card (Obverse and Reverse) for Admiralty Gunmetal.*

ALLOY No. 1 | NAME: *Admiralty Gunmetal.*

ANALYSIS.	
Copper	*88.00*
Tin	*10.00*
Lead	—
Zinc	*2.0*
Iron	—
Phosphorus	—
Nickel	—
Aluminium	—

MIXINGS.		
Material.	Grade.	Per 100 lb.
Copper	*1*	*88*
Block Tin	*3*	*10*
Pig Lead	—	—
Spelter	*2*	*2¼*
Phosphor Tin	—	—
Phosphor Copper		
Maximum % of Scrap	*25*	

PHYSICAL PROPERTIES:—

Yield Point.	Maximum Stress.	Elongation on 2 in.	Red. of Area.	Brinell Hardness.	Impact.	
—	*14.0*	*7*	—	*60*	—	Min. reqts.
8.0	*16.5*	*15*	—	*65*	*12*	Average

Casting Temperatures Degrees Centigrade.

Section.	¼ in.	½ in.	½ in.	1 in.	2 in.	3 in.	4 in.	
—	*1,200*	*1,175*	*1,150*	*1,110*	*1,090*	*1,080*	*1,070*	

GENERAL INSTRUCTIONS:

Melt copper and scrap under charcoal. Draw, add zinc and stir in, then add tin and cast.

Metallurgist.

DISCUSSION.

Before calling upon the lecturer, the Branch-President (Mr. James Smith) made sympathetic reference to the death of Mr. R. Wallis, and said that a letter of sympathy had been written to Mrs. Wallis on behalf of the Newcastle Branch. The members then stood in silence in respect to the memory of the late Mr. Wallis, who was President for the first two years of the Newcastle Branch.

The Branch-President, in opening the discussion, said he noticed that the lecturer touched upon the question of the percentage of wasters in the foundry. The scientific men of the day were doing their utmost to decrease the number of wasters, and were being fairly successful.

Mr. F. Adam said he thought that the lecture had been interesting and instructive, but he was not in agreement with certain parts of it. He understood the lecturer to say that he did not find the chemist of very much assistance, but he (Mr. Adam) could not believe that, because, in his experience, the brassfoundry could not do without the help of the chemist.

The lecturer had referred to the inconvenience caused by metal lying about the foundry, but did he not check his metal every night? In a shop where some sixty or seventy mixtures were used this was most essential. He did not think that best selected copper should contain 0.036 per cent. antimony, and he would like the lecturer's opinion with regard to antimony in any kind of gunmetal.

He considered that it was necessary to have sketches when making intricate castings. The lecturer had touched upon the question of breaking up castings in order to find defects, but surely it was rather extravagant to break up six castings. He did not agree that foundries erred on the high side with regard to temperature. About 90 per cent. of the bad castings made in the foundry were due to "drawing," caused by low temperature and not high. With regard to the ring casting referred to, did the lecturer not think that the trouble could be overcome by casting it from two places?

The Chemist and Brassfoundry.

In reply, The Lecturer said he was afraid that Mr. Adam had misunderstood his idea of the relationship of the chemist to the brassfoundry. What he meant to point out was that many people thought that all they had to do was to get a good laboratory, but unless the shops were run on a well-organised system, even the best metallurgical staff could not give entire satisfaction.

As far as possible, the residue of the scrap should be returned to the stores the same day, but, unfortunately, it was not always possible in a foundry with a large output, and it was sometimes impossible to get the heads and runners of large castings into the stores the same night.

They had found that all sorts of rubbish was very often sold as best selected copper, and therefore they generally preferred to judge the metal by the appearance of the ingots and on analysis. He should have mentioned that sketches were, of course, highly essential when dealing with intricate castings.

Regarding the breaking up of the first half-dozen castings, he would admit that was rather a loose statement, and that he should have been more careful in what he said. Of course, much depended upon the size of the casting and whether the defects were due to drawing. People were apt to look upon all sorts of defects as draws, but defects were due to high temperature as well as low. The effects of a moderate excess of casting temperature were not noticeable in the brassfoundry, and so long as the casting looked sound and had a good fracture, it was generally considered a sound casting. It was possible, however, to have a casting perfectly sound in the foundry sense, but which had a low strength. The ill-effects of high casting temperature were not so easily discernible as the ill-effects of low temperature, but he was not aware that brassfoundries were apt to err on the low side.

A great many people cast ring castings from one place, but the ideal method is to run them from about four places at once.

Incorrect Description.

Mr. H. J. Young said that he would criticise Mr. Rowe's Paper from the point of view of a scientific man. In his opinion the title of the Paper was incorrect, and, with all apologies to the lecturer, he must confess that he did not think the card system described could be called a scientific one, being similar to that used by most capable managers. He thought that the scientific part of the matter lay in knowing how far to take these systems without entailing expense beyond their worth. In their ironfoundry they used seventeen or more mixtures, and, consequently, had a large number of different qualities of pig and scrap. These were organised by the laboratory, and a card system introduced some ten years ago, since when it had been carried on, and was a side-issue not worth talking about as a scientific invention. A costing system indicating the amount of labour expended would be of greater value, but probably the accountant was more capable of dealing with it than the chemist.

He did not think the type of costing shown by Mr. Rowe was scientific, and it was unfair to say that a skilled foundryman could not do these things without the help of the chemist. The scien-

tific man, employed in a works, relied to a large extent upon rule-of-thumb methods, and could not afford to belittle them, although he might improve upon them. In his (Mr. Young's) opinion, moulding was, to a certain extent, a scientific operation, although it did not happen to be called so.

Many card systems supposed to be in operation were not kept up, and existed in theory only. He had seen some wonderful systems carried to such an extent as to entail, probably, a loss of thousands of pounds.

He was interested in the question of the auto-punch, because eight or nine years ago, at the invitation of the late Dr. Stead, he had tried one similar to that shown on the screen, which gave such unreliable results that he had not troubled further with it. Moreover, Dr. Stead said the results obtained by him were equally unsatisfactory. He was glad that Mr. Rowe had come across a punch which seemed to be successful, but personally he doubted its utility to the extent outlined by Mr. Rowe.

In conclusion, he wished to thank the lecturer for his Paper, which he thought dealt with ordinary and general foundry organisation rather than any application of science or scientific principles.

Importance of Raw Materials Cost.

In reply, The Lecturer said he was afraid that Mr. Young had also misinterpreted his remarks. Regarding the costing of labour, he quite agreed with Mr. Young that it was as much value as costing such as he had described that night. He had mentioned, however, that he did not intend to deal with that portion of a record system in a brassfoundry which was purely an accountant's job, and he had only dealt with the part which the accountant could not be expected to do.

Mr. Young should remember that 85 per cent. of the cost of bronze castings was raw material lost.

They had a number of auto-punches in use in their works, in the hardening shops as well as in the foundry, and had made a great many tests, which, within ordinary limits, were quite accurate, but the accuracy of the results depended, to a large extent, upon the constancy of the spring.

Mr. Young asked if the lecturer's remarks applied to both homogeneous and heterogeneous alloys.

The Lecturer said they did, and with the auto-punch it was possible to take about half-a-dozen readings very quickly, and so get a good check.

Mr. W. J. Paulin said the lecturer had mentioned that in some of the brassfoundries they were so crowded that the gangways were only 18 in. wide. In cases like that, what did they do when the Factory Inspector arrived? Mr. Rowe had mentioned "an ordinary phosphor bronze" containing about 90 per cent. of copper and 0.3 per cent. phosphorus. Was that not rather a low phosphorus content?

The lecturer had mentioned that hard spots were formed by tin, but did he not think that the little white patches might, in certain cases, be oxidised zinc, as some phosphor bronze castings contain a certain amount of that metal?

He would also like to know whether the phosphorus did not tend to produce an abnormal amount of oxidation in the zinc. It would also be of interest to know what the lecturer considered to be "rapid melting," *i.e.*, how many 100-lb. pots did he melt in the ordinary day.

With regard to the question of draught in crucible furnaces, coke fired, he asked whether it would be beneficially assisted if a large pipe from the furnace pit was led under the ground and outside the building, and open to the air, so as to bring in pure cold air to feed the furnace; also if this pipe was raised to an appreciable level, say 6 ft. above the ground, would that affect the draught in the chimney?

He would like to know how the lecturer dealt with heavy bosses on castings, and whether he recommended the use of chills. Nothing had been mentioned about the incorporation of nickel. During the war a great number of bands for shells contained nickel, but he understood that this metal had a bad effect upon castings, and was apt to produce a honeycombed appearance. Could the lecturer explain the reason for that?

Chilling Advocated: Nickel Alloys Discounted.

In reply to Mr. Paulin, Mr. Rowe said, with regard to phosphor bronze, that hard spots of "tin sweat" were familiar to most people. He had analysed a good many of these, and found that they contained about 18 to 22 per cent. tin, the phosphorus content being three or four times as much as that of the alloy. Tin spots were often found on the tops of castings, but were not so noticeable until the casting was machined. These defects were partly due to the casting being run too hot, and partly to improper gating and feeding.

He had never found zinc to be detrimental to the soundness of phosphor-bronze castings. Phosphor bronze was used when the casting had to withstand a considerable amount of abrasive wear. Some tests which had been carried out in America proved that phosphor bronze containing 1 per cent. zinc had a much shorter life than a bronze containing no zinc, and therefore the zinc content should be kept as low as possible.

When pouring castings slowly, it was necessary to use a high casting temperature, and, in view of this, he did not advocate slow pouring, because it was not possible to get the best strength out of the metal when using a high temperature. With regard to heavy bosses he said that he obtained the best results by chilling.

It was advisable to keep away from alloys containing nickel, as this caused porosity in castings. With reference to the question of draught, he did not think that the consumption of air in the furnace would be such that any appreciable difference would be made by the alterations suggested by Mr. Paulin. They had come to the conclusion that the natural-draught furnace was very economical, crucible life being considerably longer than in a forced-draught furnace.

Card System Criticised.

Mr. A. Logan said that the card system described by the lecturer seemed to be most awe inspiring, and he was unconvinced that it would be of great value to the brassfoundry, because, in his opinion, it was too elaborate for everyday work.

He agreed that the ring casting should be run from a number of places. He noticed that the lecturer gave a list of compositions of alloys, but had omitted the last one, that of an acid-resisting alloy, and he would like to know if there was any objection to giving that particular composition.

With regard to pyrometers, the lecturer had mentioned the case of a base-metal pyrometer being in use for three or four years, and still being accurate to about 3 deg. His own experience certainly did not coincide with that. The lecturer had also mentioned that a silica sheath enclosing a Pt—Pt-Rh thermo-couple lasted about four weeks and gave some hundreds of immersions before breaking down. They used a platinum—platinum-rhodium pyrometer with a silica sheath in their own foundry, and would be satisfied if they obtained about twenty immersions from the sheath. He would like to know if the lecturer could recommend anything to make the silica sheath last longer.

The Lecturer said he usually found that the people who objected most to recording systems were those who had never tried to run a system. As a matter of fact, this system had been cut down as much as possible, and, without these records, they would not know how the foundry was working. He thought that too many foundries relied upon hearsay, having no records to work upon. It was essential to cut down the weight of non-productive metal, and if a simple system could be instituted whereby this could be automatically done, it would help the management to keep in closer touch with what was happening in the foundry. He was sorry that he was not in a position to give the composition of the last alloy, but it was one which would resist hydrochloric acid.

Vote of Thanks.

Mr. C. Gresty, in proposing a vote of thanks to the lecturer, said that he had listened with interest to Mr. Rowe's Paper. He agreed with

several of the speakers that the card system described was very elaborate, and would be difficult to operate under ordinary works conditions, and it was therefore interesting to know that Mr. Rowe had found it practicable.

Mr. J. W. Frier seconded the proposal, and thanked the lecturer for his Paper. The elaborate system which they had seen that night did not altogether coincide with his own experience when he first entered the foundry trade, and he must admit that the rule-of-thumb methods did very well in those days.

The Lecturer thanked the members for their kind appreciation and excellent discussion.

Catalogues Received.

Cast Iron Pipes.—The April stock list of cast iron pipes is to hand from the Staveley Coal and Iron Company, Limited, Chesterfield.

Smiths' Hearths.—Messrs. Sturtevant Engineering Company, Limited, of 149, Queen Victoria Street, are circularising to the trade a three-page leaflet dealing with forges of various types.

Steel Barrows.—We have received from the Sturtevant Engineering Company, Limited, of 149, Queen Victoria Street, London, E.C.4, a leaflet describing a new line in foundry wheelbarrows.

Electric Motors.—A brochure is to hand from Messrs. Brittain's Electric Motor Company, of 110, Cannon Street, London, E.C.4, which describes their squirrel-cage and slip-ring types of electric motors.

Mechanical Riddles.—The Constructional Engineering Company, Limited, of Titan Works, Charles Henry Street, Birmingham, are circularising a leaflet dealing with a portable belt- or electrically-driven mechanical riddle. It takes any standard diameter riddle.

Foundry Specialities.—Messrs. Beecroft & Partners, Limited, of St. Peter's Close, Sheffield, have prepared a four-page leaflet which they have entitled "Scientific Facts." Core binders, brass flux, ladle flux, and their other well-known specialities are described.

Conveying and Elevating Chains.—Messrs. Hans Renolds, Limited, of Didsbury, Manchester, have sent us a handsome brochure, bound in stiff grey paper, dealing with chains for conveying and elevating machinery. The chains are made from steel. Much useful technical data is incorporated.

Electro-Magnetic Hardening Furnaces.—Messrs. Automatic and Electric Furnaces, Limited, of 173, Farringdon Road, London, E.C.1, have recently published a new catalogue dealing with an electric furnace which utilises a magnetic detector device indicating the moment when to withdraw the charge for quenching. Foundrymen are now taking more interest in the tools associated with foundry practice and a knowledge of this type of plant is desirable.

Melting Furnaces.—We have received from the Power Engineering Company, Limited, of Old Trafford, Manchester, a well-illustrated catalogue dealing with the potentialities of the U.S. Rotary Furnace. It has been designed for non-ferrous melting, and ranges in capacity from 150 lbs. to 2,000 lbs. in terms of brass. It is a tilting, oil-fired, non-crucible furnace. Actually twelve examples of typical experiments are given, showing the losses on various types of alloys. The system appears to be quite novel, and non-ferrous foundrymen are well-advised to secure a copy.

Granular Refractory Material.—We have received from Messrs Robson Refractories, Limited, 1, North Road, Darlington, a sixteen-page booklet carrying a unique design on the cover, describing the properties of Cupoline. The brochure is termed "Useful Hints to Foundrymen." The method adopted has been to deal successively with the complete lining of cupolas; the repair of cupolas; the lining of ladles; the construction of converters; the making of open-hearth furnace doors; the building of soaking pits; and finally, boiler settings. We understand that the booklet is now ready for distribution to foundrymen on application.

Iron and Steel Institute.

Annual Meeting, 1924.

As already announced, the annual meeting of the Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, on Thursday and Friday, the 8 and 9 of May, next.

The annual dinner will be held at the Grand Hall of the Hotel Cecil, Strand, W.C., in the evening of Thursday, May 8, at 7.15 for 7.30 p.m. Application for tickets (price 15s. each, exclusive of wine) should be sent in not later than Thursday, May 1.

Programme of Proceedings.

Thursday, May 8. 10.30 a.m. to 1 p.m.—General Meeting. The Council will present their Report and the Hon. Treasurer the Statement of Accounts for 1923. Election of Council.

The newly elected President (Sir William Ellis, G.B.E., D.Eng.) will be inducted into the Chair. Presentation of the Bessemer medal to Professor Albert Sauveur. The President will deliver his Presidential Address and a selection of Papers (Nos. 3 and 2) will be read and discussed.

2.30 p.m.—Papers Nos. 15, 13, 7 and 16, will be read and discussed.

Friday, May 9. 10 a.m.—General Meeting. The award of the Andrew Carnegie Research Scholarships for 1923 will be announced and a selection of Papers (Nos. 6, 14, 9, 10 and 12) will be read and discussed.

2.30 p.m.—Papers Nos. 4, 5, 11, 1 and 8, will be read and discussed.

List of Papers.

The following is a list of the Papers which are to be submitted at the meeting:—(1) "Notes on the Testing of Metal Strip," by L. Aitchison and W. L. Johnson; (2) "High Temperature Growth of Special Cast Irons," by J. H. Andrew and H. Hyman; (3) "Continuous Rolling Mills, Their Growth and Development," by J. P. Bedson; (4) "Transverse Test Bars and Engineering Formulæ," by G. S. Bell and C. H. Adamson; (5) "The Hardening of Silico-Manganese Steels," by E. W. Colbeck and D. Hanson; (6) "Recovery of Waste Heat in Open-Hearth Practice," by W. Dyrssen; (7) "The Production of Large Crystals by Annealing Strained Iron," by C. A. Edwards and L. B. Pfeil; (8) "Some Effects of the Penetration of Arsenic and Sulphur into Steel," by W. N. Hindley; (9) "On the Forging Temperature of Steels," by K. Honda; (10) "On the Indentation Hardness of Metals," by K. Honda and K. Takahasi; (11) "Hardness of Electro-deposited Iron, Nickel, Cobalt and Copper," by D. J. Macnaughtan; (12) "Experiments on the Brinell-tensile Relationship," by A. L. Norbury and T. Samuel; (13) "The Effect of Cold-work upon the Density of α Iron," by H. O'Neill; (14) "Theoretical Considerations Respecting Certain Features in the Working and Efficiency of Reversing Regenerators," by J. Seigle; (15) "The Plastic Deformation of α and γ Iron," by F. C. Thompson and W. E. W. Millington; (16) "X-Ray Studies on the Crystal Structure of Steel." Part II, by A. Westgren and G. Phragmén.

Autumn Meeting.

The autumn meeting of the Institute will be held in London on Thursday and Friday, September 4 and 5. Further particulars will be communicated to members in the ordinary course.

Empire Mining and Metallurgical Congress.

An Empire Mining and Metallurgical Congress will be held on June 3 to 6 in connection with the British Empire Exhibition at Wembley, under the auspices of the Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Institution of Petroleum Technologists, the Iron and Steel Institute, and the Institute of Metals, in conjunction with the Mining Association of Great Britain, and the National Federation of Iron and Steel Manufacturers. Viscount Long of Wraxall (President) will preside over the main sessions and at the official banquet, which will be held at the Guildhall. Those intending to take part in the Congress are requested to notify their intention as soon as possible, especially members of the Convening Bodies who are resident in the United Kingdom.

Hints on Green-Sand Moulding.*

By C. H. Brown, A.I.Brit.F.

Ramming of a Mould.

Uniform ramming of a mould is most essential to the production of good work, for despite other work being correctly carried out, if the mould is not properly rammed an imperfect casting will be the result. By this is meant, in ramming a job, the old idea of keeping 2 in. from pattern is not needed, more especially if there is a deep bracket which is to be sound. It is contended that by using the rammer with care, one can ram about up to the pattern if the job is any great depth, that is, the sides of the mould the moulder has in hand. In regard to the face of the mould, if it is to be turned over in a box, then it is best to have about 4 in. of sand and then to give it a light ramming in accordance with any particular job. The mould should have a firm face at every part, and no amount of finishing will quite make up for bad ramming. If a mould is soft in parts there may be swellings on the casting, while, at other places, where the sand has been too hard, the metal may not lie against the parts and may cause it to boil and the mould to blow, or cause the mould to be scrap.

Mould joints should be made as sound as possible. Any cutting down to parts which is needed in any particular casting should be made as sound as possible so, when the pattern is drawn, there will be a firm joint.

For bedding-in different methods are practised by moulders. In a pattern, say, 12 in. deep, a hole is made in the floor 24 in. deep, which is then filled up with loose sand to about 6 in. Sand is riddled to about 7 in., after which facing sand is added to about 1 in. This leaves the pattern to be knocked down to the level of the floor. For about 3 in. down from the face of the mould will be sound so as to resist the pressure of metal, and below the 3 in. the sand will be open and not compact because of the escape of all gases in a green-sand mould.

Ramming of Top Parts.

In regard to ramming of the top parts, the moulder has to use his judgment in what tackle is to be used. For instance, with a bracket it would not matter what tackle was used as long as the top part held in and care was taken with claywash, but in regard to a casting that has to be machined, it is necessary to study which method is best so as not have the metal boiling off when it reaches the face of the top part. Grates are not advisable unless proper care is taken when claywashing them to ascertain that the claywash is not too thick. The grates must be well shaken before putting on top of facing sand, for the tears of claywash will only find their way to the face of the top part, causing dampness, which if not removed results in defects if the casting is to be machined.

Venting of Moulds.

The necessity of providing means whereby gases can escape from the mould after having been rammed is well known, and special attention must be given to the vent wire. If venting is done imperfectly blow-holes or scrabbing, or both, are likely to occur. Sometimes the vent wire is sufficient if the gases escape directly into the air. Other cases require ashes, as for parts of jobs where there are pieces to draw-in, leaving portions of the mould practically covered with metal. A fault, common amongst moulders, is to polish the mould until the grain of the sand is broken. When such unnecessary work is performed the danger of scrabbing is greatly increased, although the venting may have been applied with intelligence.

In using water on the joints care must be taken, more especially with green castings to be machined. For instance, with small cylinder covers or pump cover it is found on machining that if the water has been freely used and not with care, blowholes generally appear about the outer edge, usually owing to the dampness on the edge of mould causing the metal to boil off.

Risers on a Green-Sand Mould.

In green-sand moulding risers should always be stopped down before casting, because the sand contains coal dust and the other ingredients. All these combine together and form gases, which escape through the vent holes when the metal is poured into the mould. Such gases are not present in a dry-sand mould.

Effects of Bad Gating.

Many evils are traceable to bad gating. One of the most common is dirt in the casting. The moulder may use a plug and fill the well before lifting it, yet when the casting is machined it may be dirty. There should be as much care in cutting the gate as there is in finishing the mould. The gates should be so placed so as to deliver the metal as nearly as possible to all parts of the mould at the same time, especially in thin castings. Many moulders believe in filling the mould as quickly as possible, which is wrong in cases where there are many cores in the mould. Where a square block has to be cast which involves exposing the top part to the heat of the metal, it is advisable to run as quickly as possible to prevent the top falling in. In a cored mould the cores keep the heat from the top part, in which case casting speeds should be moderate so as to ensure all gases coming off the cores before the metal covers the cores. This will not be so with rapid pouring in green-sand work.

Burning on Castings.

Among the many duties of the moulder, one that not infrequently falls to his lot is the repairing of castings which have become broken by accident, or the renewing of a piece of some machine that has worn away. Many times work of this repairing nature can be carried out with ease and safety, whilst other cases require considerable judgment. When a piece is to be burnt on the end of a flange of a valve it is quite a simple job, but when a boss of a wheel is to be burnt on judgment is required owing to the expansion of the wheel. It is best accomplished by putting the boss of the wheel on a small fire, so as to make it to a dull red and the arms and the outside of the wheel black. By doing so there is every chance of accomplishing the burn successfully, but, on the other hand, if the boss is heated to a bright red there is every possible chance of a failure. For a cylinder in the steam ports there may only be about 1-in. thickness before reaching the steamways. For such a proposition the foundryman would have to ram the steamways up with sand so as to make sure that the metal did not get into them.

For this purpose a cake of soft loam is made and dried. The cylinder is warmed through for about an hour and the part is lowered into the fire, allowing it to become a dull red. After removal from the fire it is burnt with a shank of hot metal, using the rod so as to make sure that the old metal has been melted. The metal is then allowed to set a little and the burn washed out, seeing that there are no signs of bubbles; should there be any signs of blowing by using the rod, one can feed the blow holes. Finally cover the burn with blacking. When set, the cylinder is again placed on the fire, building a little coke around it again, so as not to melt the edges of the casting. Occasionally the barrel core buckles and will not machine.

DISCUSSION.

Mr. Russell, in opening the discussion, said this was an essentially practical Paper. Some moulders advocated working the rammer at least 2 in. from the pattern, but the lecturer did, and he thought he was right. One can work a good deal nearer. His experience was that where one

* A Paper read before the East Midlands Branch, Mr. S. H. Russell presiding.

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rammed on a curved face it was frequently found that a scab occurred which was entirely due to ramming. There was another point where green-sand moulds went wrong when using a ramming board. They would not ram all round, but only lightly round the edges. In green sand the moulder, almost without exception, would not ram his pattern, and wasted time in making a joint by hand, and lost practically all the advantage of the board.

In bedding in, Mr. Brown said he made a hole in the floor 24 in. deep and squeezed down the pattern to the level of the floor. Did he find it sufficient, as he would not have thought a drop of 2 in. would have given sufficient solidity to 14 in. of sand?

Danger of Claywash.

Claywashing was dangerous, because it was semi-fluid, or almost entirely so, and the particles were, of course, just opposite to porous. He was thinking more of the case where a moulder liked painting the impervious clay over the face of the mould and the particles of sand got choked and there was no free outlet for the gases. He was quite in agreement that a well at the bottom of a runner gate was an aid to running. His experience was that if the well had no depth, the cold metal rising all the time and the hot metal coming at the back or three parts up or at the top, one had scum or slag. He overcame that by always having a top runner as well, and never trusted to bottom runners only

On the question of filling slowly or quickly he disagreed with the lecturer, for he always insisted on getting the mould filled as quickly as practicable, and he had never traced any bad defects to too-quick pouring but he had with slow pouring. It is a debatable point, but the slower one poured the more metal is chilling inside the mould, and this cold metal could not be warmed, with the result bad castings were made. Cores must be made with sufficiently open vents, and he always insisted on drying the cores. A generous outlet for gases and pouring as quickly as possible are synonymous with good results.

Venting Sand when Burning on.

For the burning on of castings, he thought it was advisable to ram up with sand but to vent as with ordinary core. Unless provision is made for the escape of the gases it will be found that a certain amount of blowing from the sand occurred and rather tended to "dirty" the metal in the weld and often caused failure.

He would ask the lecturer whether he had any experience of using oil or paraffin on green-sand work. The men say they get better castings, but his opinion was they did not—in fact, he was sure of it. Had Mr. Brown any experience in using sawdust in facing sand?

Mr. Brown said with regard to curves so small a thickness hardly needed ramming. They were all aware claywash was used too thickly at times. He did not believe in using it so much, but when there are lifters or grates it was essential. He believed in running all castings from the top. By running at the bottom a certain amount of oxidation resulted. Referring to paraffin oil, the lecturer confessed he used it, but perhaps without good reason. He used sawdust in facing sand, but only to a limited extent, although he thought it was advantageous in making the core more open. He added that when he was a boy he was told to do things without being given any reason. The old moulders tried to keep all the secrets, and that was the reason the moulders of to-day were not so good as in the past.

Importance of Ramming.

Mr. Bunting agreed the Paper was a very practical one. He was glad to hear the remarks on ramming, for this was the man who was wanted, he who could ram, for anyone could finish. Ramming up is the crux of the mould, and there was nothing in the finishing part. By careful ramming the whole mould was firm and there was no mending of soft places.

Another point was venting. Many moulders followed the practice, after venting a mould, of going over the surface with the needle wire. That he did not allow, but it used to be common. Was Mr. Brown favourable to needle-wiring to the surface of a mould? In his opinion it was a waste of time and a faulty process. Also, was the lecturer in favour of much venting of top parts? He was not speaking of tops that have parts overhanging, but ordinary flat-top parts. His view was that it was not necessary. He did not agree to slow running. Foundrymen all knew the theory that was put forward two years ago, but the propounder did not carry out the theory in his own shop. His contention was that, with due regard to safety, the quicker one could have the mould filled, whether cores are in or not, the better, for the cores should be made to allow the air to get away.

Mr. Brown, in reply, said he would use the wire needle only when it was found that the face of the mould was too hard, for otherwise the mould is closed to a certain amount of air. If the mould was too hard, the needle-pricker would not do much harm.

Mr. J. Lucas asked several questions and pointed out practical difficulties experienced in the shop. He thought Mr. Brown should have given in his Paper something about sand from a foundryman's point of view, for the sand mixture was put on "for luck," and that was the only use he could see in it.

Mr. Stevenson, in referring to the use of sawdust, said he used it until he discovered bits of pit props and so left it out.

A vote of thanks to the lecturer was then accorded.

Contracts Open.

Buenos Aires, May 7.—Machinery in connection with the water supply works at the town of Santa Rosa de Toay. The Department of Overseas Trade.

Chester.—400 tons of 12-in. cast-iron pipes, British standard specification, for the Chester Waterworks Company. Mr. W. S. Moss, secretary, Water Offices, 15, Newgate Street, Chester

Dublin, April 14.—Switches and built crossings, with chairs, for the Great Northern Railway (Ireland) Company. Mr. J. B. Stephens, secretary, Amiens Street Station, Dublin. (Fee, £2 2s., returnable.)

Glasgow, April 16.—(1) One or two 5-ton steam locomotive cranes with grabs, and (2) five or more 12-ton hopper-bottom railway wagons, for the Corporation. The General Manager, Gas Department, 30, John Street, Glasgow, C.2

Gloucester.—Supply and laying of a 24-in. diameter cast-iron pipe approximately 435 ft. long, for the Corporation. The City Electrical Engineer, Commercial Road, Gloucester.

Melbourne, April 30.—One drop hammer battery of 16-cwt., 10-cwt., and 16-cwt. stamps, for the Victorian Government Railways. The Department of Overseas Trade.

Nottingham, April 17.—136 tons of iron and steel work, in stanchions, ordinary and plated beams, hoppers, dished and flat flooring staircases, etc., required in connection with the North Wilford Power Station coal receiving hoppers, etc., contract No. 8, for the Electricity Committee. Mr. T. W. Gordon, city engineer and surveyor, Guildhall, Nottingham. (Fee, £2, returnable.)

Santiago, April 25.—Sea-water meters, for the Chilean Republic Authorities. The Department of Overseas Trade.

Singapore, April 23.—About 13 miles of welded steel pipe, together with certain cast-iron pipes, valves, and specials, for the Municipality. Sir A. Binnie, Son & Deacon, 30, Buckingham Gate, Westminster, London, S.W.1, or C. C. Lindsay & Peirce, 180, Hope Street, Glasgow. (Fee, £5, returnable.)

Wellington, N.Z., May 1.—Centrifugal pumps and electric motors, for the Wairoa Borough Council. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

Wellington, N.Z., July 29.—Turbines and generator for the Public Works Department, Wellington. The Department of Overseas Trade (Room 52).

Wellington, N.Z., July 1.—Pipelines, for the Public Works Department. The Department of Overseas Trade.

Some 600 employés at the Bynea Steel Works, near Llanelly, have left work because the firm refuse to reinstate a former employé, who recently went to America, and has now returned.

Some Problems in Light Castings.*

By J. C. Dorsie, A.M.I.Brit.F.

Dr. Percy Longmuir, in a recent lecture, described how the crystals in cooling arranged themselves at right-angles to the edges of the casting. Therefore, in a frame the weakest parts are at the corners where the crystals set at right-angles to each other. A further source of weakness is due to the fact that the diagonal, being longer, freezes more slowly.

With the definite object in view of making castings which would illustrate the weakness of square corners, four frames were cast as shown in Fig. 1. These are 24 in. × 24 in. outside. The flanges were 3 in. wide × ¼ in. thick. They were all run on the edge with the exception of frame B. It was only after considerable pressure that the moulder—an old stove-plate hand—was persuaded to run it as shown. He said he would need to lift it out in pieces, but it refused to oblige and broke in the mould through one of the sides, one of the edges of the break curling up over the other edge. In frame C, the centre of two opposite sides was thickened to 1 in. The casting was quite sound. The centre of the other two sides was then increased to 1 in. thick, and in this case it was removed from the mould in three pieces. It is hoped that some explanation will be given as to why the other corner remained whole.

Fig. 1.

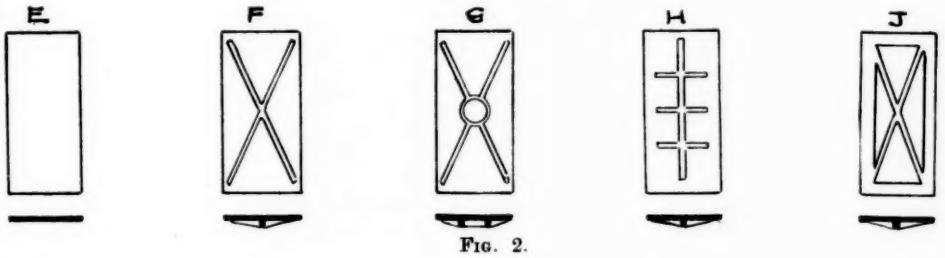

Fig. 2.

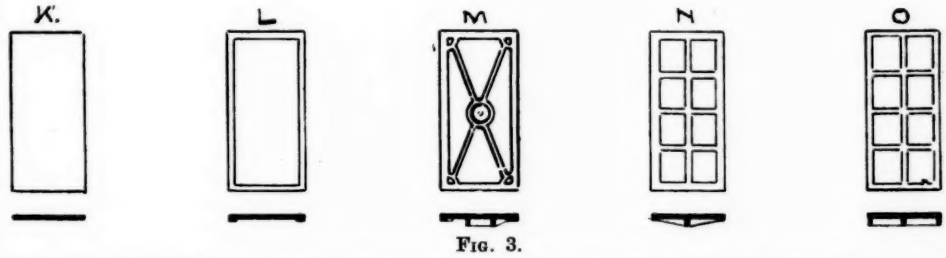

Fig. 3.

Manhole Covers.

An interesting problem at present is the designing of covers for roadway manholes that will be capable of sustaining the ever-increasing loads that are imposed on them. The simplest method is, of course, to increase the thickness of the casting, but if this idea is carried much further the roadman will require some mechanical apparatus to lift the cover. Foundrymen must therefore devise some system of strengthening the cover without unduly increasing the weight. Figs. 2 and 3 illustrate some scale models of plates which were cast with the view of comparing the efficiency of various forms of strengthening ribs. The size of the plates was determined by the capacity of the testing machine. The five types in each set were cast in one box. The tabulated results were the average of four boxes, but the records of each type were nearly identical. The types illustrated in Fig. 2 represent covers for trenches which are supported at the ends only. The experimental plates are 13 in. × 6 in. × ¼ in. thick. They were supported on end bearings at 12-in. centres, and the bolster used for transverse test was employed. This bolster is a cylinder 1 3-16 in. dia. × 3⅞ in. long. The average results are shown in Table I:—

Table I.—*Strength of Model Manhole Covers.*

Type.	Transverse in cwts.	Deflection in ins.
E	8.5	0.325
F	6.5	0.120
G	9.5	0.155
H	5.7	0.080
J	9.6	0.110

It will be noted that in types F and H the supposed strengthening ribs are really sources of weakness, and the plain plate, with its capacity for greater deflection, compares favourably with types G and J. Table II shows a comparison of the plates in terms of the weight of plate to the transverse load.

Table II.—*Strength of Manhole Covers per Unit Weight.*

Type.	Sustained per lb. of Plate in cwts.
E	1.67
F	1.14
G	1.62
H	0.94
J	1.46

The plates illustrated in Fig. 3 are also 13 in. × 6 in. × ¼ in., but they were supported on the four sides. The usual compression bolster, 2 in. dia., was used, but a spherical seating was inserted between the bolster and plate to limit the area under pressure. The results are given in Table III.

Table III.—*Strength of Manhole Cover Models Supported on Four Sides.*

Type.	Crushing Strength in cwts.	Deflection in ins.
K	15.3	0.055
L	16.3	0.070
M	19.7	0.085
N	23.4	0.050
O	20.3	0.030

* A Paper presented to the Scottish Branch of the Institute of British Foundrymen.

It is interesting to note that the system of dividing the surface into a number of small compartments by means of longitudinal and cross bracings—type N—seems to give better results than the usual design of diagonal bars connected to a central ring. Again, comparing the weight of plate to the load, the figures shown in Table IV were found.

Table IV.—*Strength of Model Manhole Covers Supported on Four Sides in Unit Weight.*

Type.	Sustained per lb. of Plate in cwts.
K	3.33
L	2.93
M	3.28
N	3.78
O	3.06

Warping of Gutters.

A perennial subject of discussion in the light casting trade is the casting of a channel section or gutter with open ends, and the amount of curvature, or camber, which must be allowed on the pattern to ensure that casting turning out straight. For economical reasons these gutters must be made in the narrowest possible box. The metal is run by flat gates direct on to the sole and flows down the sides. If the sole and sides are of equal thickness, the edges of the side will cool before the sole, and a warped casting results. This warping takes the form of a concave curvature along the sole. So decided is this warping on light gutters with shallow sides that allowance must be made on the pattern to counteract the camber. It is common knowledge among gutter moulders that this type of casting invariably rises at the ends, and if the pattern has not enough camber, a moulder can slightly reduce the curvature on the casting by "pounding" the ends of the mould. The question has been asked: "Does the casting only rise at the ends? Does it not also sink in the centre?"

Behaviour of Metal in Moulds.

For the purpose of testing the actual behaviour of the fluid metal in the mould, the apparatus shown in Fig. 4 was used. The arrangement in practice was found to be capable of improvement, but it was the simplest and cheapest that suggested itself. It consists of an ordinary gutter box with planed edges. The pattern is 6 in. × 4 in. × 7-32 in. thick × 6 ft. long. It has two plain ends instead of the usual spigot and faucet ends. The

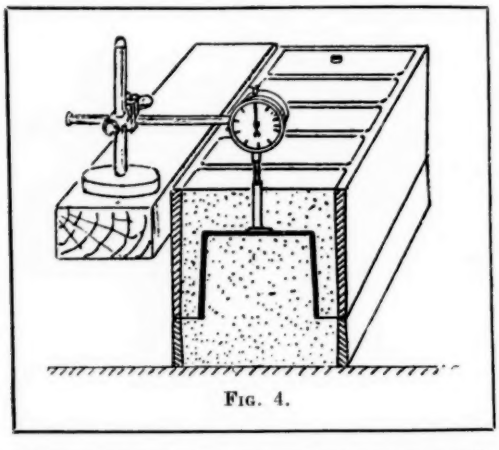

Fig. 4.

pattern was made in wood and rammed on a solid block. Three pins were rammed up with the top part and cast in the sole of the gutter. The height of each pin was measured, before pouring, on a dial gauge which registers in thousand parts of an inch. The gauge was left in position on the centre pin during the duration of the experiment, and the variations in height of this pin were carefully noted. At the conclusion of the test the height of each of the end pins was taken before the box was unhooked. It is only proposed to give the summarised results of two of the latest tests in which an extended series of dial readings on the centre pin were recorded.

In the first half minute the dial registered a rise of 17/1,000; at 3½ minutes it dropped 1/1,000; at 5 minutes it again reached 17/1,000. From this point a gradual rise took place, until at 12½ minutes after pouring the highest point was touched, 27/1,000. This point was maintained until 21 minutes, when a gradual fall took place. At 30 minutes it was 21/1,000; at 45 minutes 12/1,000; and at 60 minutes it had returned to zero. A further fall of 1/1,000 was recorded at 68 minutes, and another 1/1,000 at 73 minutes, when the test had to be suspended for the night. The gauge was left in position, and next morning it registered 5/1,000 under zero. The difference between the highest and lowest readings was therefore 32/1,000, say 1/32. The end pins were then measured and recorded at a rise of 23/1,000 and 31/1,000 respectively. The camber on the casting as it lay in the box was therefore 32/1,000, say 1/32. The hooks were then loosened, and the immediate rise of the end pins was apparent. The casting when measured had a camber of 170/1,000, say 11/64, but it has to be remembered that this casting lay in the box the whole night. Probably this accounts for the small camber. It is certainly less than the amount usually allowed for.

In two gutters with 1½ in. sides, the camber on the castings was 29/64 and 26/64 respectively, but these two gutters were knocked out of the box shortly after casting. That was before the author had appreciated the curious behaviour of the centre pin. A 6 in. × 1½ in. gutter with a round bead ½ in. deep × ¾ in. projection on each edge was then cast, and the behaviour of the centre pin was again very carefully noted. In the first minute it jumped 25/1,000, in the next minute it gained 1/1,000, but during the next three minutes it lost 5/1,000. It then gradually rose again until the highest point, 35/1,000, was recorded 13 minutes after pouring. It remained stationary for 18 minutes, when a very gradual fall took place, until 1 hour 20 minutes after casting it indicated 29/1,000 above zero, when it had to be left for the night. In the morning it registered 22/1,000 *above* zero. The end pins were 6/1,000 and 8/1,000 *below* zero. As it lay in the box the casting therefore had a convex curvature of 29/1,000, say 1/32, but when it was measured on the surface table a concave camber of 45/1,000, say 3/64, was noted.

M'Kie & Baxter, of Govan, have placed with Harland & Wolff, Limited, a contract for the hull of a small steamer for Australian owners, the machinery for which they are themselves supplying. They are also constructing the engines for the two large steamers ordered recently from the Ayrshire Dockyard Company, of Irvine; and the engines for two gunboats which are being built for a foreign Government; while for foreign owners they have an order for a despatch vessel, the hull of which will be built for them on the Clyde and the engines in their own shops.

Close upon half-a-million skilled and semi-skilled workers in the engineering industry are affected by applications for increases in wages which are being promoted by their respective unions. In the case of the Amalgamated Engineering Union the amount of the demand has not yet been definitely agreed upon. Meanwhile the National Union of General Workers has forwarded to the employers' federations in the engineering and allied trades an application for an advance of 10s. a week in the wages of all unskilled and semi-skilled workers employed in the industry throughout the country.

Members of the North-Western Centre of the Institution of Electrical Engineers held their 24th annual meeting on April 1 at the Engineers' Club, Albert Square, Manchester. The retiring chairman (Mr. G. A. Juhlin) presided. It was stated that the membership continued to increase. At present it was divided as follows:—Members, 110; associate members, 396; associates, 13; graduates, 93; students, 411. This total of 1,023 compared with that of 965 last year. Mr. H. C. Lamb (Manchester) was elected the new chairman of the Centre and Mr. A. G. Ellis and Mr. W. J. Medlyn vice-chairmen. The chairman announced that a communication had been received from the Privy Council intimating that the request of the council of the Institution that members should be privileged to use the title "chartered electrical engineer" had been granted, and no doubt the official intimation would be given to members later.

Institute of British Foundrymen.

LONDON BRANCH.

Discussion on Mr. Gardom's Paper on Malleable Iron Chain.

THE BRANCH-PRESIDENT (Mr. V. C. Faulkner) said that Mr. Gardom, probably rightly, had thrown over an established law of economics, which said that no work should be given to a skilled man when it could be done by a lower-priced man; the lecturer had his moulders running around fetching cores and sand. Again, Mr. Gardom had given no information as to the life of the annealing boxes. If he (the Branch-President) remembered rightly, Mr. Poole, when speaking on this subject, had stated that they only lasted three or four heats. A business was being developed by at least three firms for making these packing boxes in a nickel-chrome alloy.

The Migration of Elements.

Mr. Gardom had brought out a very important point when he was dealing with the migration of carbon. He (the Branch-President) agreed, except on one point, namely, in regard to peeling. Mr. Gardom had pointed out that when the rate of gas penetration was not equal to the rate of migration then peeling took place, and further, that during that period the oxygen would attack the next most easily oxidisable element, which was the iron. He would refer Mr. Gardom to the working of a Siemens furnace or any other, where he would find that the next most easily oxidisable element in ferrous alloys was the silicon, and suggested that a fusible slag of ferrous silicate was formed between the peel and the core, and so effectually prevented any more migration of carbon. He (the Branch-President) was most interested to find that Mr. Gardom had put forward the migration theory, and it should have a considerable amount of modern thought devoted to it. He had been exceptionally interested in the metallurgical side of the Paper, because the author had dealt with it in a very rational way

Temperate Movements.

MR. H. J. MAYBREY said he did not quite understand the reason for dropping the temperature during the annealing process. There seemed to him to be some sort of balanced action. If there was migration of carbon going on in the casting, the carbon could only migrate so long as it could be eliminated to the surface, and if elimination were quick migration must be quick; if slow, then migration must be slow. Therefore, he could not quite see the point of dropping the temperature during the annealing process.

Cause of Scaling.

MR. H. O. SLATER complimented Mr. Gardom upon his very instructive lecture. It was a revelation to him to know that Mr. Gardom's firm could go through the whole process of malleable iron—which was just about double that of cast iron—and still turn out chains within an accuracy of plus or minus $\frac{1}{8}$ in. in 10 ft. It was really exceptional, because he himself had lost $\frac{1}{4}$ in. on one casting alone, let alone on 10 ft. of them. With regard to the lecturer's metallurgical explanation of scaling, Mr. Slater said it seemed extraordinary to him that the malleable iron industry, which was one of the oldest in the country, should have been carried on so well without a metallurgist.

It was carried on without the aid of the metallurgist by men with no knowledge whatever of chemistry; of course, he was not belittling the metallurgists, because he recognised that they benefited the industry very much. He himself had never looked at scaling from a metallurgical point of view, but in his practical way he overcame that trouble. He considered that scaling could be caused by (1) quick heating, (2) too-long annealing, or (3) using a wrong mixture of ore. Dirt in the ore would also cause scaling, which was very detrimental to the skin of the casting. With regard to the annealing of chain links, he had noticed that the links were packed in boxes in the ordinary way and the boxes piled one on top of the other. He would like to know whether there was anything used to protect the boxes at the bottom against the weight of the boxes at the top. He had never dealt with a specialised product in malleable iron, but he had been concerned with jobbing work, such as motor-chassis work and so on, where different thicknesses and different types of castings had to be annealed in the same oven. He had found very often, in annealing heavy with light castings—which he had been bound to do, for economic reasons, although it was not altogether a good policy—that it was beneficial, if he had a casting which was liable to crack, to insert a plate half-way up, so that that plate would take the weight of the top half, and the bottom half would stand its own weight. As to the pyrometer, he must confess that when he had first attended the meetings of the Institute nobody was more prejudiced against some of the scientific instruments than himself, but as his experience and knowledge had increased he had felt that, in the malleable trade, pyrometers and other scientific instruments were really necessary. With regard to the variations of temperature in different parts of the same oven, Mr. Gardom had given no idea as to how his ovens were built, the way his flues were constructed, or how he regulated the temperature in any particular part of the oven—whether by a series of dampers in the flues. As to annealing pots, he did not consider it would be a commercial proposition to make them of nickel-chrome steel.

Embrittlement of Malleable after Ageing.

THE BRANCH-PRESIDENT said he had referred to annealing boxes of nickel-chrome alloy, not nickel-chrome steel. There was another question he would like to put to Mr. Gardom. It had been found that American black heart malleable iron was prone to suffer from embrittlement taking place a few months after manufacture, and the American Bureau of Mines had developed a heat treatment to overcome that.

Average Tests from Malleable.

MR. H. O. SLATER asked Mr. Gardom what were the highest tests he had applied to his bars—tensile, elongation and yield point—and what was his method of casting test bars. He would also like to know Mr. Gardom's ratio of coke to iron in every-day working. If he remembered rightly, Moldenke, in his book, advised a ratio of 1 to 4.

Blast Pressure.

MR. E. H. BROWN, referring to the attempt to standardise cupola working by varying the percentage of silicon in the mixtures, asked whether Mr. Gardom had tried to obtain the same result with a constant mixture and varying the blast pressure during the course of the run.

MR. H. G. SOMMERFIELD (Branch Hon. Secretary), dealing with the analysis of the metal used —3.2 carbon, 0.6 silicon, 0.25 sulphur, 0.1 phosphorus, and 0.13 per cent. manganese—asked whether that was the analysis of the metal as charged into the cupola, or of the actual casting before annealing.

Economic Employment of Skilled Labour.

MR. G. C. PIERCE said he had heard and read sufficient about malleable iron to make him say that he hoped he would never be in the position of having to deal with it. He had no burning desire to become a malleable-iron expert. But he was interested in one question raised by the lecturer, which was rather a psychological than a metallurgical one. It was true to say that Mr. Gardom had thrown over an elementary law of economics through reducing the monotony of the men's employment, but he himself was very pleased to know that there were some people in the founding industry who had some regard for the human as well as the economic side. One of the things they had to do as an Institute was to watch both sides, and not concentrate too much upon economics. Of course, they had to keep their eyes

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on the clock of progress, but at the same time he considered that very often too much consideration was given to the other side, and it was refreshing to find a lecturer standing his ground and saying he could defy an economic law and yet maintain the same output as he would have done if he had not defied that law.

Pattern Plates.

Mr. G. Hall, referring to the pattern plate used by Mr. Gardom, said it was certainly a very fine piece of work, but he would like to know why Mr. Gardom preferred that to an ordinary double-sided metal plate or the wooden pattern produced by the pattern maker. It had been said that it could not be produced on a match plate. He had seen wooden patterns and had used them in the foundry, and the joints had been as nearly perfect as possible. Mr. Gardom's pattern was a very elaborate piece of work, but he should have thought that it could have been produced so as to be much stronger, to last longer, and would be perhaps cheaper. He himself sometimes had a pattern such as that shown by Mr. Gardom made with a plaster of paris odd side, but not for the purpose of producing castings by the thousand. If he were producing thousands of castings, he had a metal pattern, either single- or double-sided, made to match the box on one side of the plate.

Hard Spots from Grinding.

Mr. Summers asked whether, in malleable iron, it was easy to create hard spots on the casting by grinding too much locally. For instance, if there were a big lump to be got off, and the casting were held too long on the emery wheel, would that result in the creation of hard spots?

THE AUTHOR'S REPLY.

Mr. Gardom then replied to the discussion. With regard to the Branch-President's question as to cleaning castings, he said they were tumbled, and dust extractors were used. That was the only method of cleaning used before passing them into the annealing department.

Elimination of Monotony to Promote Production.

With regard to the question of the moulders getting their own cores and so on, the main point was output; he was not considering the moulder so much—though that would probably disappoint Mr. Pierce. He believed that he obtained a greater output by eliminating monotony. If the Branch-President wanted to use the argument he had done, why had he not asked how many more moulders would have been available if somebody else had brought their cores along for them? It must be remembered that there was only one man on each of the portable machines, and that man was doing all the work in connection with his machine. If he stopped, the machine stopped, but the fact that the moulders fetched their own cores did not upset the production to anything like the extent it would if automatic machines were used, where an automatic machine was turning out perhaps ten times the number of moulds that a hand machine would. He quite agreed that if an automatic machine were used—hydraulic or air—it was not advisable to stop the machine, but with the particular type of machine used in his foundry he could afford to do it simply because the output of the machine was not affected very much as the result of the machine being idle for a certain time. With regard to monotony, there were many people who were referring continually to apprenticeship in the foundry, but one must face the fact that the apprentice in the foundry was a thing of the past. It seemed to him that moulding as a skilled job was finished.

A Voice: Not yet.

Mr. Gardom said that, at any rate, it was on its last legs. For instance, in the production of his own particular product, his firm could train a boy or a man who had never seen a foundry before to do this work accurately in three weeks. The skill was needed in the preparation of the work. That was where the foundries had to look for the apprentice, and the man who prepared the patterns was the man who had to know his job. When such a pattern as he had shown that evening was put into the work it must be perfect; if it were not perfect, then back it would go to the pattern shop; if the moulder had to touch it up then output decreased. He was sorry for the apprentices, but we must face the fact that moulding—which he quite admitted was an artist's job—was dying out.

Cost of Nickel-Chrome Boxes.

Dealing with annealing boxes, he said that, for the particular oven he had mentioned, the cost of an oven load of pans was £300—and the firm made them themselves. The cost was about 3d. per lb. On the other hand, the lowest price at which he had had nickel-chrome offered to him—but not delivered—was 2s. 6d. per lb. He simply could not afford to use it, and did not know that anybody else could. Again, he had never yet found nickel-chrome to stand up to all the conditions which the makers claimed. He had used it for pyrometer sheaths, and had found it was quite usual for it to give only six months' service. That was nothing when one came to consider the extra cost involved. As to the life of the annealing boxes, he had carried out careful tests and could safely say that he got 10 heats out of them. The Branch-President had referred to some special boxes mentioned by Mr. Poole. He (Mr. Gardom) had tried them, and had got only four heats out of them.

Does Silica Formation Cause Peeling?

With regard to the migration of carbon and peeling, the point about it was that, working on the theory he had expounded, he had obtained results—and results which he could understand. Was silica formation responsible for peeling? The Branch-President had thought that one might have the silicon oxidising and preventing further migration of carbon. He would like the Branch-President to go further into the matter. One could get peeling by forcing this oxidation faster than the migration; it could be obtained by using too strong an ore, or on a sample which still showed white iron in the centre, *i.e.*, with a carbon content of about 2 per cent. Such a sample could be re-annealed and the carbon removed. That more or less broke down the theory that silica formation stopped migration. In his own experiments he had annealed a bar first in the ordinary way. Then the difficulty was to say how far the drillings were to be taken off. Some people took a drill and drilled through $\frac{1}{8}$ in., then another, and then another. He himself put it in a lathe and turned off $\frac{1}{8}$ in., and then another, and so on, and he certainly considered that, by taking the whole of the sample for the carbon estimation, he obtained better results than were obtained by drilling. He could check it better, and he did get every part of the particular $\frac{1}{8}$-in. depth he sought. He had re-annealed the sample and had repeated the test, to see whether migration went on, and undoubtedly he could obtain a peeled casting with a hard iron in the centre. One could bring all the factors that caused skinning under one definition if it was said that "skinning takes place when the rate of carbon diffusion from the interior to the surface is less than the rate of carbon elimination at the surface by oxidation."

Dropping Temperature during Annealing.

It had been asked by Mr. Maybrey why the temperature was dropped during annealing. If the temperature was not dropped then de-carbonisation on the outside took place faster than the migration from the centre, and if that happened skinning would result. If one annealed at a temperature below the critical temperature of de-carbonisation, no more de-carbonisation would take place, but migration could still take place.

Contraction of Chain Castings.

In reply to Mr. Slater, with regard to the contraction of $\frac{1}{4}$ in. in 10 ft. of chain, he would like to say that he did not for one moment claim that none of the links varied by more than the amount obtained by dividing the number of links in 10 ft. of chain into $\frac{1}{4}$ in. One might be slightly over and another slightly below, and they equalised each other right through. He agreed with Mr. Slater that this malleable work was done before the advent of the metallurgist, but it was poor

stuff. The point about it was that when a metallurgist left his firm another metallurgist could come in and carry on the job from his predecessor's notes. The practical foundryman could not say that. If a practical man had worked with him for ten years, that man might be able to take on the work and improve on it, but he did not leave anything behind him when he died which would help the work on.

Migration and Skinning.

He was in agreement with Mr. Slater that skinning could be caused by quick heating, too long annealing, too strong ore, and by dirt. With rapid heating there was rapid de-carbonisation without the correspondingly rapid migration. With too long annealing, also, de-carbonisation was bound to be faster than migration, and the same applied when too strong an ore was used. As to the prevention of distortion in annealing, usually between every two pans he placed a cap. At one time he used to cap up outside the pans, the cap extending right through the pans to the outside. At present, however, he put the cap just inside. Sometimes there was distortion at the top, due to bad packing. The practical man would not understand that in packing ore a far better packing was obtained with a poker than with a rammer. With a poker we were able to get in between, and the ore would sink much better.

Pyrometers.

With regard to pyrometers, he assured his hearers that since he had been with his present firm, the men employed in unloading castings, and who were paid by piece work, agreed with the use of pyrometers, because they could make larger quantities. When he went there at first they used sledge hammers to get out the castings.

Dampering Furnaces.

With regard to dampering, that was another point on which he seemed to differ from most people. If the castings were not heated properly he should not say he could not do them in that particular oven, but should set about putting right the oven. That was what had been done in his foundry. They had fired from the outside of the oven, and the fire came in at the top of the oven. That was wrong according to all theories. There were dampers all along the bottom side, and pyrometers also. They worked by means of the dampers, and the heat was drawn to whatever part of the oven it was required. As soon as the temperature dropped at a particular spot the heat was increased there, and when the temperature was too high at any particular spot it could be let down.

Test Bars and the Importance of Yield Point.

Dealing with test bars, Mr. Gardom said that for his iron he obtained about 22 tons tensile, 5 per cent. elongation, and a yield point of 17 tons per sq. in. If he had said that in his Paper, those present would have said that the Americans could do better than that. He knew they could; so could he if he took it beyond the realms of commercialism, and annealed for a period about three times longer than he did actually. A test bar did not always give the actual results obtained with the product itself. He obtained 10 tons per sq. in. on nearly all types of chain produced. The reason he mentioned it was that when the Americans came out with their black-heart process and said that they got 10 per cent. elongation, the English people came along and tried to repeat it. There had been much discussion about semi-steel and what it was; that could easily apply to black-heart and white-heart malleable. Why should we try to make a metal appear to be something which it was not? They did not require the same tests from a 0.9 carbon steel as from a 0.2 per cent. carbon steel, but that was what the Americans were doing with malleable. The reason his iron was better for this work was that the yield point was about 17 tons per sq. in., whereas in the black heart it was only about 12 to 14 tons per sq. in. If the chain were used on a chain drive, and it reached a point which was beyond its yield point, *i.e.*, when it was stretched, then it would get over the top of the sprockets and would break. It was not a question of maximum stress but of yield point, and that was the reason why Reaumur material was better for this particular job, as it possessed a higher yield point. The position was exactly the same with a ball bearing. A 1-in. ball would stand 40-tons pressure before it would break. But the yield point on a 1-in. ball, or the point of permanent deformation, was only 7 tons, and that was the point at which it failed, because the moment it was permanently deformed the point of contact was lost.

Varying Blast Pressure or Composition.

Replying to Mr. Brown as to the varying of blast pressure during the run in the cupola, Mr. Gardom said it seemed that the easiest thing to do was to vary the mixture. Certainly he could vary the silicon, but he would not vary the sulphur. He did not say that the variation of the blast could not be done, of course, but it was easier to vary the mixture. Actually the blast pressure was dropped during the run, because at the commencement the cupola was full, and more pressure was needed to get through the charge than when it had dropped down. Therefore it was necessary to lower the pressure as the iron dropped down.

In answer to Mr. Sommerfield, Mr. Gardom said the analysis he had given was the analysis of the iron as cast. He might, of course, change his mind with regard to the analysis at any minute. He simply used that analysis at the moment because he considered it most suitable for the job. With regard to the division of the carbon. At the commencement the total carbon was 3.2 per cent.; it was entirely in the combined state. At the finish there was somewhere about 1 per cent., but that varied slightly (after annealing) up to 1½ per cent. But he could say it was only 0.8 per cent.

Silicon and Growth.

A question had been asked about the action of the silicon with regard to growth. Of course, a high silicon content, say 2 per cent., did make the casting grow, but the point that had struck him particularly was the variation in pitch. With a silicon content of 0.57 per cent., with the particular analysis mentioned, there was no growth. If the silicon and the sulphur content were increased one obtained the same result, he believed—although he had not finished the test—because it seemed to be dependent on the way the carbon was precipitated. If precipitated as temper carbon a growth was obtained, so that if one used the black-heart process there was a growth of ⅛-in., and so resembled the single contraction conditions as in grey iron. But with the white-heart malleable there was a double contraction, as in the case of steel. If the total carbon were high, precipitation was more liable; if the silicon were higher, precipitation was assisted; sulphur retarded precipitation; manganese combined with the carbon and retarded precipitation; phosphorus had very little effect, except that if it were present in any quantity it formed the phosphide eutectic, and it was advisable to keep it away.

Hard Spots and Grinding.

With regard to the creation of hard spots in castings during grinding, it was easy, of course, in any type of malleable to do this. For instance, the white-heart malleable was practically pearlite, which when heated returned into solution, and if the temperature were raised to about 800 deg. the carbon also went into solution; if it was cooled quickly there was hardening. The same thing applied in the black-heart process, but there the temperature must be taken higher, because the carbon only came back into solution at 900 deg. or more. Hard spots were easily formed by grinding, and it could easily break castings, so that if there were much to grind off only a little should be removed at a time.

Coke Ratio.

As to the ratio of coke to iron, it worked out to a ratio of about 10 to 1. He believed, unlike Mr. Slater, that slow melting was beneficial because one had to consider the final result. If it produced high total carbon it had to be removed when annealing. The cost of annealing was very

high, and if foundrymen could do anything to reduce the annealing time it would pay to do so.

Vote of Thanks.

Mr. G. C. Pierce, in proposing that a very hearty vote of thanks be accorded to Mr. Gardom for his splendid Paper, touched again on the question of foundry apprentices, and said he wanted to tell Mr. Gardom and anybody else interested in that question that perhaps they were wrong when they considered that skilled moulders would not be necessary in the future. As a basis for his argument, Mr. Pierce said that, 25 years ago, the scientific apparatus used in the foundry for production purposes was nil, whereas to-day its use was increasing very rapidly, and there was no comparison between the two conditions. There had been great strides in so far as methods of production were concerned, and yet there is nearly twice the number of skilled moulders to-day that there was 25 years ago. Therefore, the theory that skilled moulders were going out was erroneous. If he were correct—and he believed he was—then surely, if we progressed in the future to the same extent as we had in the past 25 years, he had as much justification for thinking we should want more skilled moulders as others had for thinking that we should want fewer. In fact, he had more justification for adopting his point of view.

The vote of thanks was accorded with acclamation.

Mr. Gardom, after expressing his thanks, asked Mr. Pierce whether, in referring to the extra number of moulders employed at the present time, he had taken into account the extra weight of iron turned out at present as compared with 25 years ago.

EAST MIDLANDS BRANCH.

Annual Meeting.

The annual meeting of the East Midlands Branch of the Institution of British Foundrymen was held at the Loughborough College. Mr. S. H. Russell (Leicester) was in the chair.

The Hon. Secretary, Mr. H. Bunting, reported the year began with 85 members, of whom seven left and twelve joined, leaving a net membership of 90. Five meetings were held during the year and two joint visits, one in February to the Stanton Ironworks and the other to the International Combustion Works. The average attendance was 36 and last year 27. Three Council meetings had been held and one Sub-Committee for the library. The membership was distributed —35 at Derby, 22 Leicester, 15 Loughborough, and 18 outside.

The balance sheet showed the year began with £18 17s. 9d. in hand; members' subscriptions, £89 15s. 6d.; Branch share of subscriptions, £30 11s. 10d.; amounts in syllabus, £7; bank interest, 2s. 6d. The payments included the £89 15s. 6d. to Headquarters, £21 printing and stationery (which was for 18 months' work), and £6 9s. 6d. library. Meetings cost £6 4s. 10d. A sum of £11 10s. 6d. was reserved for the library, and the balance in hand was £7 4s. 10d.

The reports and balance sheet were adopted.

Mr. E. Stevenson moved the re-election for a second year as President of Mr. S. H. Russell, and Mr. A. S. Clarke seconded, Mr. Russell briefly responding.

The Vice-Presidents elected were Messrs. E. Stevenson (Nottingham), H. Pemberton (Derby), J. E. Cox (Ilkeston), and J. Lucas (Loughborough). Mr. Russell moved the re-election of Mr. H. Bunting as Hon. Secretary, and in seconding Mr. Clarke thought they ought to give some tangible recognition of Mr. Bunting's services. The President said he hoped before he concluded his term of office to carry out the wishes of members in this respect. They all fully appreciated the value of the services rendered by Mr. Bunting.

On the voting for members of the Council, Messrs. T. Goodwin (Derby), J. J. Reffin (Leicester), and R. Cook (Derby) were appointed.

Messrs. T. A. Spiers (Leicester) and J. Lucas were appointed delegates to the General Council of the Institution, and Messrs. Hilton and Goodwin auditors.

COVENTRY BRANCH.

Discussion on Mr. Dicks' Paper on "A Pattern Shop Talk."

The Branch-President (Mr. C. Dicken) said they had heard a very instructive and interesting Paper dealing with a class of work which was unusual in Coventry. Nevertheless, many points had been raised which were of general interest.

Mr. Shaw referred to a detachable head for a cylinder with water-jacket complete, and asked if a mahogany pattern would be sufficient to obtain six per week for twelve months, or if it would be policy to have a metal pattern. Would the increase in the initial cost of the pattern be compensated for?

Mr. Elgie inquired whether the little arrangements mentioned by the lecturer were on the market. In his opinion, it was a good plan to mark out to standard rule and then add the contraction figure. The lecturer had stated that, in the case of wooden pattern plates, he did not think it was advisable to get below 1¼ in. thick. That, he (the speaker) considered, depended upon whether they were using soft or hard wood.

The President mentioned that some years ago he had a number of fairly heavy patterns made in teak, and he found they had double the life of mahogany. So far as the pattern-makers of Coventry were concerned, however, they would not use teak. He did not know whether it was that they found it too gritty or whether it would not take to the glue. In his experience, however, he had not found any wood to surpass teak.

The Author's Reply.

Replying upon the discussion, Mr. Dicks said that, as regarded the detachable cylinder heads, he would have to know the conditions in the foundry before answering the question. As to Mr. Elgie's remarks with regard to pattern plates, he adhered to his statement that, in the case of a wood plate, it required to be 1¼ in. thick to prevent springing when being rammed. He agreed that teak was an excellent wood for patterns. Pattern-makers, however, were always against using teak because it was so difficult to cut. If they started to cut the end way of teak, they would soon lose their temper.

Mr. Dicks was heartily thanked for his Paper.

Personal.

Mr. C. A. Newton, a director of Newton Bros. (Derby), Limited, electrical engineers, has been re-elected president of the Derby Chamber of Commerce.

Mr. John Powell, the divisional superintendent of the Great Western Railway at Swansea, retires under the age limit on April 24, after 50 years' service. He will be succeeded by Mr. John Lea, of Reading.

Mr. J. Gray Buchanan, a partner in the firm of William Jacks & Company, Winchester House, Old Broad Street, London, E.C.2, has been elected a director of Brands' Pure Spelter Company, Limited, of Irvine.

Dr. W. R. Ormandy has been elected president of the Institution of Automobile Engineers, together with Mr. L. H. Hounsfield, Mr. B. W. Shilson, Mr. H. Kerr Thomas and Mr. Charles Wheeler as vice-presidents. Messrs. F. A. S. Acres, C. R. Charles, W. Chater-Lea, A. J. Hancock, W. H. Hingston, W. J. Iden, H. F. L. Orcutt, P. A. Pappe and F. G. Woollard, and Dr. F. W. Lanchester and Prof. W. Morgan have been elected to the council. A very interesting practice has just been introduced by the Institution in that a graduate is selected by his fellows to speak, on behalf of the graduates, in the discussion on every paper read at a general meeting.

Wills.

Neil, T., lately secretary to the North-Eastern Steel Company, Limited ...	£10,472
Thomson, J., of Saltwell View, Gateshead, Durham, iron merchant	£7,186
Nuttall, Sir Edmund, Bt., engineer and contractor, of Edmund Nuttall & Company, Manchester	£267,731
Bean, Sir George, of Oakham Lodge, Dudley, Worcs., chairman of A. Harper, Sons & Bean, Limited	£166,129

Company News.

Metropolitan-Vickers Electrical Company, Limited.—Dividend, 8 per cent. on ordinary shares for year.

Thomas Smith's Stamping Works, Limited. — Interim dividend, 6d. per share, less tax, on ordinary shares.

Stanton Ironworks Company, Limited.—Dividend on 6 per cent. preference shares for half-year ending March 31.

British Empire Steel Corporation.—Payment of dividends on all shares of corporation and subsidiary companies deferred.

Nantyglo and Blaina Ironworks Company, Limited.—Instalment, £2 per share, less tax, on account of preference dividend arrears.

Ashton Engineering Company, Limited.—Capital £1,000. Secretary: E. H. Weaver, 31, Hillaries Road, Gravelly Hill, Birmingham.

Forth and Clyde and Sunnyside Iron Companies, Limited.—Dividend, 10s. per share, free of tax, on ordinary; carried forward, £28,378.

Engineers (Wales), Limited.—Capital £1,000 in £1 shares. Directors: A. F. Rankin, Castle Buildings, Swansea, and Dr. S. G. Morris, J.P.

James Cartland & Son, Limited.—Net profit, £5,006; brought forward, £7,424; dividend, 5 per cent. on ordinary; employés' pension fund, £200; carried forward, £7,436.

John Summers & Sons, Limited.—Credit of profit and loss account and carried forward at December 31, 1922, £197,146; reserve fund, £100,000; carried forward, £203,542.

Scottish Tube Company, Limited.—Profit, £34,472; brought forward, £11,336; total, £45,808; further dividend, making 5 per cent. for year on preference; carry forward, £13,249.

Ernest C. Koop, Limited, Spencer House, South Place, London, E.C.—Capital £32,000 in £1 shares. Metal manufacturers. Directors: Mrs. M. A. Koop, C. Koop, and W. Koop.

Carnforth Hematite Iron Company, Limited.—Loss, £14,026; debenture interest, £7,062; transferred to depreciation reserve, £5,000; debit of £98,341 brought forward increased to £124,429.

Metal, Ore & Chemical Company, Limited, Bilbao House, New Broad Street, London, E.C.—Capital £10,000 in £1 shares (9,000 8 per cent. cumulative preference, 250 founders, and 750 ordinary).

Cyril W. Massey & Company (Manchester), Limited.—Capital £5,000. Metal merchants, etc. Directors: C. W. Massey and W. Wayles. Secretary: C. W. Massey, 26, Fontaine Road, Streatham, London, S.W.

Dillwyn & Company, Limited.—Loss on year's trading, £363; interest on investments, £871; refund of excess profits duty, £2,242; available, £16,113; transferring to preference share capital reserve, £500; carried forward, £12,846.

Ransomes & Rapier, Limited.—Disposable balance, £38,920; dividend, 6 per cent. on preference shares, less tax, £691; dividend, 10 per cent. on ordinary shares, free of tax, £12,358; reserve fund (making £65,982), £5,000; carry forward, £20,870.

Lancashire Dynamo and Motor Company, Limited.—Depreciation, £8,678; debenture interest, £2,041; loss, £2,513; brought forward, £487; transferred from the reserve account, £5,000; available, £2,974; year's dividend on 5½ per cent. preference shares; carried forward, £211.

Barrow Hematite Steel Company, Limited.—Credit balance, £110,623; brought forward, £4,256; debenture stock interest and redemption fund, £91,610; expenses of debenture stock issue, final instalment, £9,861; cumulative dividend on first preference shares, £2,262; carry forward, £11,145.

A. Reyrolle & Company, Limited.—Profit, £63,239; brought forward, £16,969; Royal Victoria Infirmary and Armstrong College, £400; available, £79,808; dividend, 7 per cent. per annum on preference shares, £2,800; dividend, 12½ per cent per annum on ordinary shares, £35,000; reserve account, £25,000; carried forward, £17,008.

A. E. Clegg, Limited, 20, Belinda Street, Hunslet, Leeds.—Capital £3,900 in £1 shares, to take over the business of engineers and machinery manufacturers carried on by B. W. Clegg & Son (Leeds), Limited, and to adopt agreements with A. E. Clegg. Directors: A. E. Clegg (governing director), Lt.-Com. S. Taylor, and T. B. Holt.

Parker, Winder & Achurch, Limited.—MR. G. G. BRODIE (chairman) stated at the annual meeting last week that the results achieved were totally disproportionate to the work entailed. Competition was extremely keen, and consequently orders were hard to obtain; prices were unremunerative and unstable, credit uncertain, and payments delayed. Further, heavy taxation, dear postal rates, and reparations unsettled made business difficult to run.

Henry Bessemer & Company, Limited.—The facts that they were doing a much increased trade, but were handicapped by want of modern plant at Sheffield, and also by the possession of their Bolton works, were emphasised by the chairman (SIR WALTER PRESTON) at the annual meeting on March 26. The chairman referred to the new policy of the directors, that the Bolton works, which were an encumbrance, should be closed down as far as possible, and that the Sheffield works should be extensively re-equipped. The Bolton works had, consequently, closed down the departments where the principal losses were occurring. In Sheffield their policy of improvement had been proceeded with as quickly as possible, and £17,000 had been voted for new plant, which it was hoped would be installed and in operation before the end of the year. Their output during 1923 had steadily increased, and at the Sheffield works their output of tyres and axles last year was 100 per cent. greater than in 1921, and over 50 per cent. greater than in 1922. During the first three months of this year the output of tyres at Sheffield was 40 per cent. greater than during the corresponding period of 1923. It was part of their policy that the Sheffield improvements should be financed out of the realisation of their Bolton assets. A capital loss attributable to Bolton must be expected, but what such loss might be depended upon such factors as the possible improvement or further depreciation of Lancashire assets.

British Aluminium Company, Limited.—The 14th annual meeting of the British Aluminium Company, Limited, was held in London, LT.-COL. STEPHEN H. POLLEN (vice-chairman) presiding. The chairman, in moving the adoption of the report and accounts, said the net profit amounted to £362,704, compared with £229,235 for the previous year. At the commencement of the year the demand was increasing, but prices were low. As the year advanced the demand progressively improved, but prices for their larger contracts showed a relatively small increase until towards the end of the year. The net result was that, though they marketed a larger tonnage, the average prices were little in excess of the previous year. By the end of the year prices reached a basis more in accordance with the cost of manufacture, the demand showed no diminution, and there was a pleasing increase in the demand for the products of their rolling mills. With regard to the interest acquired in a company in Norway having two aluminium factories, both these factories had been brought to full production late in 1923, and this year they anticipated material benefit from the investment. The Board had for a long time carefully considered the Lochaber water-power scheme, and were satisfied that the time had arrived to proceed actively with the undertaking. The Trades Facilities Act Advisory Committee had decided to recommend the Treasury to guarantee a loan of £2,000,000 for the purpose of developing the hydro-electric works. The intention was to complete the developments covered by the Act of 1921 in stages.

British Insulated & Helsby Cables, Limited.—Presiding at the 28th annual meeting at Liverpool last week, MR. JAMES TAYLOR, J.P., said that the company continued to do a fairly large export trade in its cables and accessories, but at the same time it had to be realised that several of the countries to which in time past they used to send their goods were now closed, or being closed, against them, as the result of local tariffs. He specially mentioned Canada, Japan, and, to some extent, Australia, as well as India. It was true that, as against foreigners, preference had been granted for their goods in some of those countries, but taken altogether the growing tendency was for each country abroad to manufacture more and more for themselves the commodities that they had been in the habit of supplying. Just what effect that would eventually have on the export trade, of course, remained to be seen. While the above remarks were correct in themselves, it was not to be forgotten, of course, that many countries were developing electrical power, and, as a consequence, required to buy goods of the class that they manufactured, and it might be that this extra development of requirements would mean that they would continue to export on a somewhat liberal scale. The present state of the order book would seem to confirm this view, as they had taken a considerable number of orders since the first of the year, and at the present time the factories were—and had been for some months past—very busy indeed. They had more hands at work at the present time than perhaps they ever had before. During last year they paid to their employés in wages £835,000, as against £772,000 the previous year, and in the last ten years they paid out a total of £7,178,000. During the same time they had paid out £1,424,000 in debenture interest and dividends, which meant that for every £1 paid to shareholders £5 had been paid in wages. They had also paid during the same period £773,000 in Imperial taxes.

XUM

Trade Talk.

The wages regulated by the sliding scale under the Midland Iron and Steel Wages Board will be advanced 5 per cent. from Monday, April 7, to Saturday, June 7.

Douglas Elliot & Company, Limited, iron and steel merchants, Atlas Chambers, King Street, Leeds, have appointed Mr. E. A. Royle as their representative for Lancashire.

Hugh Wood & Company, Limited, Sun Buildings, Newcastle-on-Tyne, have transferred their Manchester office from Trafford Park to Westminster Buildings, Prescot, Lancs.

Before the members of the Sheffield Metallurgical Association, on April 1, Mr. J. C. W. Humfrey read a paper on "Internal Fissures in Steel," Dr. Rogers presiding.

At a meeting of the Association of Drop Forgers and Stampers, in Birmingham recently, Mr. Leslie Aitchison delivered a lecture on "Laps, their production and prevention."

In accordance with the Summer Time Act, 1922, the period of summer time in this country will begin this year at 2 o'clock, Greenwich mean time, on the morning of Sunday, April 13.

The Glasgow Iron & Steel Company, Limited, have secured the contract for the whole of the cement required in connection with the construction of the new Shieldhall Dock at Govan.

The British Engineering Standards Association have issued a report on ball joints which should be of interest to designers who give special attention to the various controls.

Grauer & Weil, Limited, 133 to 141, Rosebery Avenue, E.C.1, have now patented a machine with which any flat sheet can be ground and polished. It is applicable to polishing chrome steel sheets.

A fire broke out at the works of J. Brockhouse & Company, Limited, axle makers and ironfounders, Hill Top West Bromwich, recently. It was, however, extinguished before very serious damage was done.

The British Reinforced Concrete Engineering Company, Limited, are removing to more commodious premises on April 12, when their address will be:—King's Buildings, Smith Square, Westminster, S.W.1.

The imports of foreign iron ore at the Senhouse Dock, Maryport, during March amounted to 10,400 tons, compared with 11,350 tons at the corresponding period of last year. No iron ore was imported during February.

The New Zealand Cabinet has accepted the tender of Sir W. G. Armstrong, Whitworth & Company, Limited, for the construction of a section, eighteen miles in length, of the east coast main trunk railway at a cost of £461,050.

Mr. I. D. Norman, of I. D. Norman & Company, 25, Penybryn Road, Gabalfa, Cardiff, together with a partner, have opened offices at 99, The Exchange, Docks, Cardiff, under the style of the Exchange Engineering Company.

Evered & Company, Limited, brassfounders, of Surrey Works, Smethwick, are closing their London office at 30-35, Drury Lane, W.C.2, and will in future handle all London business through their branch at 143, High Street, Shoreditch, E.1.

Recently Mr. G. H. Griffiths delivered a very interesting and instructive lecture on "Steel Wire Ropes" to the students in the Mining Department of the Municipal Technical School, St. Helens. Mr. Griffiths is technical representative of the firm of John & Edwin Wright, Limited, Universe Wire Rope Works, Birmingham.

The extensions to the works of A. Reyrolle & Company, Limited, to which reference was made in the last report, were not completed until this year, and were therefore not available for production during last year. The expenditure on account of these extensions and the necessary plant and equipment, up to December 31, 1923, amounted to £111,001.

As the outcome of the periodical examination of the books of the employers in the Scottish manufactured iron trades under the conciliation and arbitration agreement, the workers become entitled to an immediate advance in wages of two and a half per cent. The average net selling price for the period, namely, January and February, is £12 4s. 6½d. per ton.

The Vickers-Spearing Boiler Company, Limited, of 20, Kingsway, W.C.2, have during the last two weeks been successful in securing the following contracts for boiler equipment, namely:—Aberdeen Corporation Electricity Works, two boilers, 36,000 lb.; Dover Corporation Electricity Works, one boiler, 30,000 lb.; Kingston-on-Thames Electricity Corporation, one boiler, 30,000 lb.

The Staffordshire Iron and Steel Institute have decided to award the first bronze medal of the Institute (since the inauguration of the medal two years ago) for research in a technical institution in the counties of Shropshire, Staffordshire, Warwickshire and Worcestershire, to Mr. Francis G. Dodd, one of the students of the Department of Metallurgy at the County Technical College, Wednesbury.

As a result of the unsettled conditions at the port, Southampton has lost a contract amounting to a quarter of a million pounds. The Great Western Railway Company called for tenders for the construction of two cross-Channel steamers. The tender of J. I. Thornycroft & Company, Limited, was the lowest received, but owing to the lack of confidence that the contract would be completed within the specified period, the Great Western Company regretted that they were unable to place the work with the local firm.

A representative party of Dutch journalists, accompanied by the director of Zeeland Steamship Company and two prominent Dutch business men, recently visited the works of Herbert Terry & Sons, Limited, Redditch. Upon arrival the visitors were invited to lunch, which was presided over by Mr. Alfred E. Terry, supported by Mr. C. Douglas Terry. After lunch the party was conducted through the Redditch works of the company, where they saw the various processes of manufacture of springs, washers, wirework, presswork, capstan lathe work, etc.

The Chancellor of the Exchequer received at the House of Commons recently a deputation from the Association of British Chambers of Commerce, which was introduced by the president, Sir Arthur Balfour. Sir Arthur expressed the opinion that the unemployment problem could only be solved by an increase in trade. The time had come, he said, for an inquiry into the cost of living, and he called attention to the high rate of wages paid to Civil Servants and municipal workers compared to that which industry and commerce could afford to pay to skilled workers. Sir Arthur called attention to the question of Allied debts, and pointed out that it was unfair that Britain, with nearly 1,200 millions owing to her from France and Italy, should have to meet, under such hampering conditions, the tremendous competition in export trade from those two countries.

Several changes have taken place in the properties in which the Barrow Hematite Steel Company, Limited, are interested. At the Anticross Mine, near Dalton-in-Furness, advantage has been derived from the installation of an electrical pumping plant. The company's interest in the Beni Felkai Mining Company in Algeria has been sold on satisfactory terms. The contract for ore, however, has been retained. The Wyndham Mine, in Cumberland, has been closed, this having become unremunerative owing to heavy expenditure on pumping and general cost of working. The explorations for further deposits of ore have also been unsuccessful. The directors have reason to be satisfied with the investments in the Ulcoats Mining Company, Limited, and in the Camerton Coal & Firebrick Company, Limited; recent developments in the latter property have shown areas of coal not previously reported upon. The modernisation of the equipment at the colliery is progressing satisfactorily.

Gazette.

The South Eastern Steel & Products, Limited, are being wound up voluntarily. Mr. C. S. Goddard, 46-47, London Wall, London, E.C., and Mr. F. Holt have been appointed liquidators.

The shareholders of the Pembroke Dock Engineering & Dry Docks Company, Limited, have decided to wind up the company voluntarily. Mr. P. H. Walker, 4, Park Place, Cardiff, has been appointed liquidator.

Obituary.

Mr. G. Wilkinson, member of the executive council of the Amalgamated Engineering Union, died recently, at the age of 57. He was secretary of the Toolmakers' Society.

Mr. A. E. Tucker, analytical chemist, has died at Sutton Coldfield, aged 70. He had been in practice in Birmingham for forty years, was a Fellow of the Institute of Chemistry, a Fellow of the Chemical Society, and a member of the Society of Chemical Industry. He was official analyst to the London Metal Exchange.

Mr. Robert Lupton, who was well known among Leeds engineers, died recently, after a long illness, at Quarry Mount, Hyde Park, Leeds, in his 80th year. For over 40 years, including several as manager, he was associated with the well-known firm, now out of existence, of Shepherd, Hill & Company, machine tool makers, Hunslet. He was the oldest member of the Leeds Association of Engineers, having been connected with it almost since its inception, and he had filled the offices first of president, and then for a considerable period of secretary.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The position in the Cleveland iron market during the past week has been marked by increasing strength, the buying movement then noted having developed still further activity with the satisfactory result that stocks accumulated of late have been practically sold out, and prices consequently are again on the upgrade. Another gratifying feature of the situation is a steadier tendency of market operations, due in some measure, doubtless, to more stable conditions of the French and Belgian exchanges, the enhancement of the franc values having brought Cleveland iron on a more competitive level with Continental makes than has been the case for a considerable period. For home consumption also there has been a notably more active demand, and some big lines have been purchased for Scotland. With regard to export business, it is the exchanges, of course, that need watching, and the credit position, too, is much more difficult than ever it was in the past. In the home trade current industrial unrest is the disturbing factor, and until this difficulty can be surmounted no great developments can be expected. Pig-iron smelters view with concern the prospect of dearer fuel as a result of the negotiations with the miners, even if there should be no strike. Still, on the whole, the feeling is to keep pig-iron values at a reasonable level and to encourage expansion of business on sound, steady lines. At the moment No. 3 stands about 95s. per ton. No. 1 is very scarce, and is quoted at 100s., though this, perhaps, might be slightly shaded. There is not much No. 4 foundry nor No. 4 forge about, the former being about 1s. below and the latter some 2s. per ton below No. 3.

The market for hematite also evidences some improvement, and with some prospect of an early expansion of demand in the steel industry values indicate a slightly better tendency, the quotation for East Coast mixed numbers having hardened to 99s. per ton, with No. 1 from 6d. to 1s. per ton extra. On the North-West Coast Bessemer mixed numbers are quoted lower at 112s. 6d. per ton delivered at Glasgow and Sheffield, and 117s. 6d. per ton delivered at Birmingham. Low-phosphorus iron is in fair request by high-class steel manufacturers in the Midlands, and nearly all the make of this quality of iron is being absorbed.

MANCHESTER.—Business in the local market for pig-iron continues dull and somewhat depressed, but a little more buying of foundry quality may be reported, although conditions are still adversely affected by the slackness in the engineering industry in the district, which means, of course, a decreased demand for castings of all descriptions. It is, however, probable that although the consumption of foundry iron in Lancashire has been low during the last three months, yet a good many ironfounders must be getting through the stocks bought by them fully three months ago, and some renewal will no doubt be necessary in April and May. At the moment Derbyshire makers are very firm at 95s. on trucks for No. 3 iron, or about 103s. per ton delivered locally. At present there does not seem much chance of any reduction in this price, although it is generally admitted that the industries using pig-iron are in urgent need of cheaper material.

THE MIDLANDS.—The firmer tendency in foundry pig reported last week is fully maintained, but at last week's Birmingham market buying has been on a more restricted scale, the majority of merchants and large consumers having apparently covered for a little time ahead. Practically no foreign foundry iron is coming into this district, as the difference in price is not sufficient to warrant going abroad. Prices are as under :—Derbyshire No. 3 foundry, 95s. ; Staffordshire No. 3 foundry, 95s. ; Northants No. 3 foundry, 92s. 6d.

SCOTLAND.—So far, the improvement noted in other pig-iron markets has not yet extended to Scotland, although there is unquestionably a more cheerful feeling in evidence in the industry, based on the prospect that the demand for Cleveland iron will spread in this direction. Scottish smelters are consequently a shade firmer in their ideas, but there is virtually no change in prices to report. No. 3 foundry is still being offered freely at 100s., f.o.t. furnaces, and although there has been a shade more business doing, there is still very great scope for improvement. In the complete absence of competition from the Continent, No. 3 Middlesbrough is being offered as high as 100s., f.o.t. Grahamston, with No. 4 foundry 1s. per ton less.

Finished Iron.

Business in this section of the market continues satisfactory as far as makers of the best brands of marked iron are concerned, but mills rolling the lower-grade bars have but poorly filled order books, and work is intermittent, being unaffected by the demand from wagon builders. Prices, however, are firmly maintained for marked bars, which have advanced to £15 f.o.t., with £12 10s. delivered for crown quality. Nut and bolt iron from the Continent is being offered at £9 delivered stations here for June delivery, but it is understood that very few transactions are taking place even at this price, which is £2 10s. per ton below the Staffordshire makers' figure. Lancs. and Yorkshire bars have been advanced 10s.

Steel.

Movements in the market for steel and its products are again restricted within narrow limits, the recent pressure of Continental competition, although slightly abated in consequence of the improvement in exchange rates, being still experienced in deliveries now coming to hand on contract terms. With a difference of something like £2 in the price, it is easy to see that British makers of basic billets are in a difficult position. Acid billets are reported to be rather better, but there is no pressure of business. Very little business is passing in the market for alloys, but there have been one or two urgent calls for prompt delivery of small lots of ferro-silicon of 45 per cent. grade, which have been filled from local supplies. Prices are inclined to be very hard, with a tendency to stiffen even further. The inquiry for tinplates has only been very moderate, and the business which has resulted, so far, anything but large. Makers, being fairly well booked up on the whole, are not disposed to reduce prices, not more than about 1½d. representing the fall on the week; 24s. 6d. has been taken, but 24s. 7½d. was paid in many cases.

Scrap.

Only a moderate amount of buying is reported in the various markets for scrap metals, demand showing a marked decrease in steel material, especially, in which very few transactions are now recorded. In the Lancashire market for foundry scrap there is not much change to note. Pig-iron prices keep firm here, and dealers do not see why they should give way in regard to scrap, but although there has been lately a little more buying of pig-iron, founders do not seem at all anxious to place any large orders for cast scrap. The prices in Lancashire range from 85s. to 92s. 6d. per ton, according to quality. In Scotland good heavy machinery cast-iron scrap is still stagnant at 97s. 6d., with ordinary at 5s. per ton less. Old C.I. chairs are being quoted at the same price as machinery cast, but the inquiry is rather poor. Light cast iron and firebars are 77s. 6d. to 80s. per ton. The above prices are all delivered f.o.t. consumers' works.

Metals.

Copper.—Business in the standard copper market during the past week has evidenced a rather steadier tendency, with values on the whole at somewhat higher levels. Considerable agitation is in evidence among American interests to have a tariff imposed on copper imports, as it is stated that present prices of 13 cents a pound do not permit American companies to operate profitably. With a surplus of copper increasing once more as a result of the output of South African and South American mines, it is considered that, unless a tariff is imposed, American companies will have to face still lower price conditions for refined copper before the year ends. Current quotations :—*Cash* : Thursday, £65 7s. 6d. ; Friday, £65 5s. ; Monday, £64 10s. ; Tuesday, £64 ; Wednesday, £64 2s. 6d. *Three months* : Thursday, £65 5s. ; Friday, £66 2s. 6d. ; Monday, £65 7s. 6d. ; Tuesday, £64 17s. 6d. ; Wednesday, £64 17s. 6d.

Tin.—Although considerable fluctuations in values were experienced in standard tin last week, the tendency of market movements has been favourable to the view that confidence is being re-established, and that a more active buying movement is in progress of development. Ricard & Freiwald's statistics of tin for March are appended :—

STOCKS, LANDING AND AFLOAT, EUROPE AND AMERICA.—United Kingdom : Stocks in London, 1,054 tons; stocks in other ports, 2,218 tons; total, 3,272 tons. Landing and in transit, 645 tons; afloat from Straits, 1,315 tons; afloat from Australia, 175 tons; total United Kingdom, 5,407 tons. Holland : Banca spot, 1,468 tons; Banca and/or Billiton afloat to Europe and America, 340 tons. Continent : Straits afloat, 1,100 tons. United States : Spot and landing, 1,802 tons; afloat, 9,505 tons; total visible supply, 19,622 tons.

Current quotations :—*Cash* : Thursday, £265 10s. ; Friday, £266 ; Monday, £266 10s. ; Tuesday, £259 10s. ; Wednesday, £254 10s. *Three months* : Thursday, £264 10s. ; Friday, £265 ; Monday, £266 15s. ; Tuesday, £258 10s. ; Wednesday, £254 10s.

Spelter.—The activity recently reported in the market for this metal has now subsided to some extent, leaving values irregular. Producers have not followed the reaction and visible supplies are far from plentiful. Unfortunately, the galvanising trade is not good, and makers are not booking new orders of any volume. Current quotations :—*Ordinary* : Thursday, £33 16s. 3d. ; Friday, £33 17s. 6d. ; Monday, £33 17s. 6d. ; Tuesday, £33 5s. ; Wednesday, £32 15s.

Lead.—In the market for soft foreign pig the intrinsic position has been completely overshadowed by other factors. Consumers have remained out of the market, and in the absence of their interest, dealers have hesitated to commit themselves. Some further liquidation by speculators has taken place, and in consequence the value of lead has again fallen. Current quotations : *Soft foreign (prompt)* : Thursday, £34 12s. 6d. ; Friday, £34 7s. 6d. ; Monday, £33 15s. ; Tuesday, £33 17s. 6d. ; Wednesday, £33 7s. 6d.

Book Review.

Foundry Work, by W. Roland Needham. Published by Messrs, Blackie & Son, Limited, 50, Old Bailey, London. Price, 2s. 6d. net.

This little book has been written especially for apprentice moulders. The wording and illustrations are of the simplest character. No attempt has been made to introduce any metallurgy, beyond mentioning a composition in the last chapter. At the end of each chapter, of which there are 14, a suitable list of questions is appended. Its perusal makes one wonder whether recent authors have visualised the requirements of the apprentice in the various localities of Great Britain. Most authors assume, perhaps rightly, that their readers will be trained in a jobbing foundry, but we feel sure that the time has arrived for the modification of works on foundry practice, so that a section—if not a whole book—could be specially written for the specialised apprentice. By this is meant. that a book should be written for apprentices being trained in motor-car foundries, in stove-grate foundries, in textile or marine-engineering works, and so on.

The book under review is divided into fourteen chapters, the first of which deals with the position of the foundry with reference to engineering. It is followed by others dealing with sands and sand mixing; moulding tools and boxes; cupola practice; moulding. Chapter VI describes the behaviour of the metal in the mould, and if this serves to fire the imagination of the junior its inclusion is to be commended. Other chapters are devoted to cores and core ovens, green sand, dry sand and loam moulds. The chapter on moulding machines should either have been elaborated or deleted, as but little of the subject can be conveyed in four small pages. Brass and steel founding are each given one small chapter, whilst the last one is devoted to miscellanea and some general conclusions. The book will be appreciated by teachers looking for a really elementary and inexpensive treatise to use as a class book.

Catalogue Received.

Pyrometers.—The Cambridge & Paul Instrument Company, Limited, of 45, Grosvenor Place, London, S.W.1, have recently circularised to the trade Booklet No. 1. As foundries require a number of totally different types of pyrometers for the various operations, melting, heat treatment, core and mould stoves, this 71-page brochure will be of considerable help, as we believe it is one of the few catalogues which outlines the features of pyrometers for all temperatures. We understand that this concern will send the booklet to any interested foundryman.

A meeting of the Sheffield Branch of the Institute of British Foundrymen was held on Friday, March 21. when a paper was given by Major A. Rhydderch, of Sheffield, on "Moulding Sands." The president (Mr. J. Shaw) was in the chair. During the evening a presentation of a handsome silver cigarette case was made by the members to Mr. W. A. MacDonald, on retiring from the position of secretary. Mr. MacDonald has occupied that position for four years, during which time the branch has gained many new members.

Newcastle Convention.

It was announced at a meeting of the Newcastle Branch of the Institute of British Foundrymen, held last Saturday, that the Convention Fund now amounted to £575.

The following letter has been circularised to the secretaries of the various branches of the Institute :—

Dear Sir,—I shall be glad if, at your next meeting, you and your Council will draw every possible attention to the forthcoming Annual Convention of the Institute, to be held at Newcastle-on-Tyne on June 4, 5 and 6.

My Committee is sparing no effort to make certain that this Convention shall be most enjoyable and profitable for every visitor. A cordial welcome is ensured to all members and the ladies who accompany them.

You will observe, from lists published in the Foundry Trade Journal, that we are receiving generous support from many subscribers. The programme will contain an attractive selection of works' visits, outings and entertainments, together with, of course, a number of interesting Papers.

At the same time, my Committee feels that the ultimate success of their endeavours depends upon having a large gathering, and this advance notice is sent in order that you and your Council may give it as much publicity as lies within your power.

The programme and circular is to be issued shortly, and, in order that adequate arrangements may be made for the comfort and convenience of all, we desire to impress upon your members that their prompt reply will be essential.

I may add that negotiations are in progress with the Railway Companies with a view to obtaining cheap-fare facilities.

I am, yours faithfully,
(Signed) Colin Gresty,
Hon. Secretary Convention Committee.

French Foundry Congress.

The Association Technique de Fonderie have decided that their annual convention shall be held in Paris on November 21, 22 and 23. An innovation is to be introduced by the confining of the Papers to be presented to the following subjects :—Standardisation of patterns; standardisation of costing methods; use of special cast-irons; foundry defects, and an experimental and scientific study of sands. Additionally, non-ferrous foundrymen are being asked to choose a subject of general interest.

Foundry Queries.

Sand and Coke.

Our foundry has an output of from 15 to 20 tons per week of general small castings, mostly made from green sand, and the heaviest being about 30 to 35 cwt. We are desirous of knowing what should be the average consumption of sand of all kinds to the ton of castings moulded, also the quantity of coke consumed to the ton of metal run.—G. F.

Loco Cylinder Mixtures.

The remarks of "Cylinders" and your subsequent suggestion are very interesting, and the non-acceptance of Cylinder Castings made of Steel-mix cast iron should provoke considerable discussion. Provided that the correct methods are adopted, it is possible to make in steel-mix cast iron almost any type of casting which can be made in ordinary cast iron. We are in touch with ironfounders who are successfully making such castings, including automobile cylinders, loco cylinders, chilled rolls, etc., and it would therefore be interesting to learn the views of engineers who object to the introduction of steel into cast iron.—C. J. Stokes, St. Peter's Close, Sheffield.